

CANADIAN PUBLIC HEALTH JOURNAL

DEVOTED TO PREVENTIVE MEDICINE

VOLUME 27

August, 1936

NUMBER 8

The Complement-fixation Reaction in Variola

JAMES CRAIGIE and F. O. WISHART

Staphylococcic Infections of the Bovine Udder

GWATKIN, HADWEN, and LEGARD

Psychiatric Nursing and Mental Hygiene

E. R. DICK

Progress in Public Health in Canada

C. G. POWER

An Outbreak of Haemorrhagic Smallpox

MCINTOSH, CARDER, and DOLMAN

PUBLISHED MONTHLY BY THE
Canadian Public Health Association
105 BOND STREET, TORONTO, ONTARIO

Annual Examinations, 1936

**CERTIFICATION OF SANITARY
INSPECTORS IN CANADA**

THE annual examinations for the certificate (C.S.I.(C.)) to be granted by the Canadian Public Health Association will be held in certain provincial centres on September 23rd, 24th and 25th.

The examinations will be practical, oral and written, and will extend over three days. One day and a half will be utilized by the candidate in making a report on an assigned local inspection and for the conduct of the oral examinations. Three written examinations covering the subjects of the syllabus will occupy the remaining day and a half.

A syllabus outlining the subjects of the examination and the requirements for registration, together with an application form and a list of recommended text and reference books and other publications, may be obtained by addressing Dr. J. T. Phair, Secretary of the Committee on the Certification of Sanitary Inspectors.

Applications must be received by the Secretary of the Committee on or before Monday, August 24th, 1936.

CANADIAN PUBLIC HEALTH ASSOCIATION

105 BOND STREET

TORONTO 2, ONTARIO



CANADIAN PUBLIC HEALTH JOURNAL

VOL. 27, NO. 8



AUGUST, 1936

A Recent Outbreak of Haemorrhagic Smallpox in British Columbia*

J. W. MCINTOSH, B.A., M.B., D.P.H.¹

E. D. CARDER, B.A., M.B.²

and

C. E. DOLMAN, M.B., B.S., M.R.C.P., D.P.H., Ph.D.³

THE following account of a small outbreak of smallpox which occurred recently in British Columbia is believed to embody several points of interest to health officers, epidemiologists, and laboratory workers.

On December 1, 1935, a ship inbound from Japan was detained in quarantine at William Head, B.C. One of the crew had died at sea of smallpox, and another was then convalescent from a severe attack of confluent smallpox which had developed at sea on November 12th. This patient was taken ashore and the entire crew vaccinated. They were all bathed and their effects were fumigated. Quarters where the two cases had been confined were cleaned and fumigated. Nine members of the crew who did not show a good immunity reaction to vaccination were detained. The rest were sent back on board, and the ship was released and sailed on December 3rd. The Medical Health Officer of Vancouver did not receive notice till the day following the ship's arrival in Vancouver.

The ship arrived in Vancouver on December 5th, having been held up by fog in the Gulf of Georgia for 24 hours. One of the crew was ill, complaining of sore throat and a cold, and was sent at once to St. Paul's Hospital. Had it not been for the delay by fog, this man might have wandered at large in the

*Presented before the Section of Vital Statistics and Epidemiology at the Twenty-fifth Annual Meeting of the Canadian Public Health Association, Vancouver, B.C., June, 1936.

¹Medical Health Officer, Vancouver.

²Epidemiologist, Vancouver.

³Director, Provincial Board of Health Laboratories, Vancouver; and Research Member, Connaught Laboratories, University of Toronto.

city and an extensive epidemic would probably have ensued. As it was, a series of only three cases followed, with two deaths.

Case 1. H., seaman, aged 24.

On admission to hospital, appeared acutely but not seriously ill. Complained of intensely sore throat and marked general discomfort, with pains in back and legs. Skin was clear, save for acne, and the patient thought that he had caught cold while the ship was fog-bound on the way to Vancouver. Had been successfully vaccinated when 2 years old, and at the site of the revaccination done four days ago there was an "accelerated" reaction. He was isolated, in charge of a special nurse, who, however, did not remain on duty all night. On December 9th a number of small papules appeared on the wrists, fore-arms, and behind the ears. A diagnosis of smallpox was made and the patient was removed to the Isolation Hospital. The other patients along his corridor at the former hospital, as well as all nurses and internes there, were vaccinated.

On December 19th, ten days later, all the lesions had dried up and only a few crusts remained. A small vaccination scab was still present. Six or so dried crusts were collected from the patient at this time and sent to Dr. James Craigie at the Connaught Laboratories, University of Toronto, for standardization of an anti-vaccinial rabbit serum prepared by him for use in a variola complement-fixation test. A positive reaction was given, Dr. Craigie reporting that complete fixation of complement occurred up to 1:1000 dilution of dry weight crusts. The disease ran a mild course, and the patient was discharged on December 26th.

Case 2. W., herbalist "doctor", aged 65.

While no definite history of contact with the foregoing patient could be traced, this patient is known to have visited his wife one night while she was ill in St. Paul's Hospital in a ward adjacent to case 1; and it is surmised that he entered the wrong ward, approaching close to the bedside before realizing his mistake. Was taken ill December 18th, a rash appearing on the 21st. Was not seen by a physician until December 26th, when he presented the appearance of a severe case of confluent smallpox. He was removed to the Isolation Hospital, where he died December 31st. This patient claimed to have been vaccinated in childhood and again in Japan about 25 years ago. About seven hours after death, several pustules and their contents were removed from the body and sent to Toronto. A strongly positive variola complement-fixation reaction given by this material was reported.

Case 3. C., male, aged 62.

On December 17th had been transferred to Grandview Hospital from the General Hospital annex, with a discharging carcinoma involving the cervical glands. On January 4th felt malaise and had a mild fever. A papular rash appeared January 6th and the patient was removed to the Isolation Hospital, where the rigid precautions proper to a case of smallpox were observed, although for several days the diagnosis remained in doubt. The patient had been vaccinated 40 years previously. The rash developed many of the characteristics of severe discrete variola, but the systemic symptoms appeared only very mild. Further, chickenpox was prevalent at the time, and no contact with any case of smallpox could possibly be traced during the 18 days spent in Grandview Hospital prior to the onset of symptoms. These facts led to a diagnosis of varicella being favoured at this time. On January 8th several pustules and their contents were mailed to the Connaught Laboratories, Toronto, for a variola complement-fixation test. A telegram arrived on January 15th stating that the specimen had given a strongly positive reaction for variola. A similar result was given by a duplicate specimen received at the Provincial Board of Health Laboratories in Vancouver, complement being fixed when a dilution of 1:1600 of a saline suspension of the material from a few pustules was used as antigen, the antibody being a standardized anti-vaccinial rabbit serum kindly sent by Dr. Craigie.

All efforts to trace the source of this patient's infection proved unsuccessful, but the most plausible assumption would seem to be that he received a "professional" visit from case 2 while in Grandview Hospital, at a time when case 2's incubation period was almost over. Such an assumption, however, would involve an incubation period of at least 18 days for case 3. This patient recovered after a long convalescence; but he was kept isolated for some time in hospital, and later at home, because of the remote possibility that pus discharging from the carcinoma might carry variola infection.

Case 4. Patient W., age over 60.

No history of previous vaccination. Was in hospital with nephritis, in the same ward as case 3, whom he had on one occasion helped to move in bed. Was vaccinated as a contact on January 8th, when it became known that case 3 had developed smallpox. Fell ill on January 16th and a rash developed on January 20th. This proved to be the so-called lobster-type variola and the patient died the next day, January 21st, thus confirming in dramatic fashion the laboratory diagnosis of case 3.

No further cases occurred, a fact which is doubtless chiefly attributable to the efficiency of the local isolation technique and to the care and celerity with which 111 contacts of these four cases were traced by the Quarantine Officer, Mr. S. C. Kinniston, and vaccinated.

In addition to the two cases of smallpox at sea, and to the three consecutive cases of smallpox in Vancouver consequent upon the arrival in this port of a seaman with the disease, one further case occurred among those of the crew who had been detained at William Head Quarantine Station. We are indebted to Dr. H. E. Tremayne, Quarantine Officer at William Head, B.C., for supplying information relating to the three cases which did not occur in Vancouver.

Case A. Died at sea on S.S. "Prince Rupert City", of confluent smallpox. Date of death not ascertained.

Case B. W., age 20. Never vaccinated. Developed smallpox on November 12th while at sea and was convalescing from a severe attack when the ship arrived at William Head on December 1st. Discharged as non-infectious on December 23rd, badly pock-marked. Dr. A. M. Menzies, Acting Provincial Epidemiologist, kindly arranged for crusts to be collected from this patient. These were sent to Dr. Craigie, who reported a strongly positive variola complement-fixation reaction.

Case C. B., age 50. Vaccinated in childhood. Vaccinated again at William Head on December 1st, but was detained owing to no satisfactory immunity reaction being shown. On December 5th vaccination seemed to be taking and he felt well. Complained of headache and nausea on December 7th, temperature 100°. Next day his temperature was 103°, and the characteristic variolous eruption appeared on the forehead. The eruption slowly progressed until it had become confluent by December 13th. Two days later the lesions were becoming haemorrhagic and early on the 17th he died.

DISCUSSION

In this small outbreak of smallpox, which began with a death at sea, four men of a ship's crew, and three male citizens of a port of call, took the disease. Of the seven cases four died. The vaccination histories are noteworthy. Nothing is known in this connection about the man who died at sea. Of the other fatalities, case 2 claimed to have been vaccinated in childhood (about 60 years ago) and again 25 years ago; case 4 had never been vaccinated prior to 8 days

before the onset of symptoms, or 13 days before death; while case C had been vaccinated in childhood, some 45 years ago, and was re-vaccinated 6 days before the onset of symptoms, or 16 days before death from variola. Of those who recovered, case 1 had been vaccinated in infancy 22 years previously and again 4 days before the onset of symptoms; case 3 had been vaccinated on one occasion only, as a young man about 40 years ago; while case B had never been vaccinated.

These facts clearly demonstrate the necessity for re-vaccination at regular intervals. None of the patients involved in this series of cases had been vaccinated less than 22 years before exposure to this virulent strain of variola virus. Moreover, although case 1, who had been re-vaccinated 4 days before the onset of symptoms, suffered the least severe attack, protection against even fatal infection with variola was not conferred upon case 4 by primary vaccination 8 days before onset, or upon case C by re-vaccination 6 days before onset of symptoms.

The general efficacy of compulsory vaccination of contacts, with strict isolation of cases, is admirably illustrated in this outbreak, which was held to small proportions chiefly by the operation of these measures. Owing to the fog and the consequent delay, case 1 was already ill on arrival of the boat at Vancouver; otherwise he might have been at large in the city long enough to have initiated a big epidemic. On the other hand, it seems probable that no further cases would have occurred on the mainland had not case 2, as we presume, fortuitously blundered into the room in which case 1 was isolated in hospital. The element of chance, which plays so important a part in determining the extent of every epidemic, certainly featured largely in this one.

Another noteworthy point of interest is the long incubation period (at least 18 days) which would seem to be required in order to fit the most plausible interpretation of the circumstances surrounding the transfer of infection from case 2 to case 3. Further, the strain of variola virus involved in this series of cases maintained its high virulence from the time it left Japan on the S.S. "Prince Rupert City" in the person of case A until it was buried in Vancouver with the corpse of case 4 some 3 months later.

Finally, this communication reports, as far as we know, the first use of the variola complement-fixation test for the confirmation or establishment of the diagnosis during an epidemic of smallpox. The tests were carried out by Dr. James Craigie and Dr. F. O. Wishart at the Connaught Laboratories, University of Toronto, on specimens sent from 4 of the 7 cases and in each instance a positive result was given by very high dilutions of the antigen. A test done in duplicate at the Connaught Laboratories, and at the Provincial Board of Health Laboratories, on specimens from case 3 showed indubitably that variola and not varicella was the correct diagnosis. Facilities are now available at the Provincial Board of Health Laboratories, Vancouver, for the performance of the variola complement-fixation test. Incidentally, the variola complement-fixation test has recently been performed at these Laboratories on material from two cases in which the diagnosis of variola had been considered; and the negative result obtained established the diagnosis as severe varicella.

The Complement-fixation Reaction in Variola

JAMES CRAIGIE and F. O. WISHART
Connaught Laboratories, University of Toronto

INTRODUCTION

OBLING (1906) obtained complement fixation with an extract of calf vaccine and sera from vaccinated calves. Subsequently a number of conflicting reports appeared regarding the complement-fixation reaction in vaccinia, many of which are difficult to evaluate because of lack of essential information. Sugai (1909) succeeded in demonstrating complement-fixing antibodies in the blood of smallpox patients and this was confirmed by others. References to many of these reports are omitted here, but will be found in a paper by Parker and Muckenfuss (1933). The reported failures to obtain positive reactions were probably largely due to the use of insufficiently potent sera, unsuitable antigen extracts, and an insufficient period for fixation. Gordon (1925) obtained consistently positive results with vaccinia, using sera from hyperimmunized rabbits. In the case of variola he reversed the procedure of previous workers, testing extracts of smallpox crusts with antivaccinia serum instead of testing the patients' serum with vaccinia or variola extracts. Bedson and Bland (1929) obtained positive results with guinea-pig vaccine and immune serum and showed that a longer period of incubation than had been employed by others gave better fixation. Schultz, Bullock and Lawrence (1928) were unable to obtain complement-fixation and contended that any fixation observed by others was referable to bacterial contamination of the vaccine used for production of the immune serum and also as test antigen. It was shown by Thompson, Hazen and Buchbinder (1932) that the fixation reaction with vaccinia immune sera could not be explained in this way and that the reaction was specific for vaccinia irrespective of the tissue in which it was propagated. Following the suggestions of Bedson and Bland they employed ice-box fixation for eighteen hours. Gilmore (1931), using ice-box fixation, also confirmed the specificity of the reaction by demonstrating complement-fixation with vaccine virus cultured by the Maitland technique and immune rabbit sera. Gilmore also obtained positive reactions with each of eight sera from cases of alastrim and suggested the use of culture virus for the detection of complement-fixing antibodies as a diagnostic test in smallpox.

Parker and Muckenfuss (1933), using hyperimmune vaccinia sera, examined vesicle fluid from thirty-eight cases of smallpox and five of vaccinia, controlling the tests with material from fourteen cases of varicella and thirteen cases of dermatitis. Thirty-five of the variola specimens and all of the vaccinia specimens gave positive results while all the control specimens were negative. They used

serum prepared against testicular virus since in one instance they obtained fixation with a cutaneous virus serum and fluid from impetigo which was heavily infected with *Staphylococcus albus*. Craigie and Wishart (1934, a) made a study of the complement-fixation reaction in vaccinia with a view to determining the most suitable conditions for its demonstration. The technique thus adopted has been applied to variola crusts and vesicle fluid to determine its suitability as a diagnostic test. Before reporting our observations and suggesting a technique for this test, it is necessary to make a brief reference to the antigens of vaccinia-variola virus which are predominant in *in vitro* reactions. Two reactions with immune serum may occur with crude extracts of virus-infected tissue: (a) a precipitin reaction with antigens in solution and (b) a true agglutination of the elementary bodies. Complement-fixation occurs both with the elementary bodies and the soluble precipitable substances, the latter reaction being much more marked (Craigie and Wishart; 1934, a). The same authors found that both the elementary bodies (1934, b) and the soluble precipitable substances of vaccinia (1936, a) produced and reacted with the same antibodies and that these antibodies were of two kinds. One antibody reacts with a thermolabile component (L antigen) and the other with a thermostable component (S antigen) of the LS virus antigen. Both the L and S antibodies are present in varying proportions in the sera of vaccinated rabbits and rabbits hyperimmunized with unheated vaccinia. It was therefore necessary in the further investigation of the complement-fixation reaction of vaccinia and variola virus to differentiate the reactions due to the L and S antibodies respectively.

The complement-fixation reaction may be applied to the diagnosis of variola in two ways. The patient's serum may be tested for antibodies by means of vaccinia or variola antigens. While this method requires further investigation in the light of what is now known of these antigens, it is attended by the limitations imposed by the patient's antibody response and is nullified if the patient has been previously vaccinated. The other method, used by Gordon, and by Parker and Muckenfuss, and which will be discussed in this paper, depends on the recognition of the virus antigens in the focal lesions of the disease.

EXPERIMENTAL

Methods

Preparation of Antigen—The specimens examined comprised crusts and vesicle and pustule fluid, most of the latter having been allowed to dry on swabs or in tubes. The dried specimen was allowed to macerate for a few hours in 8.5 per cent NaCl. In the case of dried fluid or swabs 0.2 cc. of this solution was used, only the impregnated tip of the swab or swabs being removed for extraction. After several hours at room temperature 1.8 cc. of neutral distilled water were added, any cotton wool squeezed dry and removed, and the suspension centrifuged at high speed for 20 minutes. Crusts were weighed and to amounts up to 40 mg. 0.2 cc. of 8.5 per cent NaCl were added. During maceration the crusts were broken up thoroughly with a glass rod, and 1.8 cc.

of distilled water added when the crusts were reduced to a gelatinous mass. The complement-fixation test was carried out on the supernatant thus obtained.

Since the LS antigen of vaccinia retains its solubility after desiccation, drying of the specimen does not prevent subsequent extraction of the antigen but this, however, must be efficient. Strong NaCl solution in which the proteins of the dried fluid are more readily soluble, accelerates dissolution of the specimens. Some of the dissolved protein coagulates out when the distilled water is added and this provides a clearer solution than when 0.85 per cent NaCl is used for extraction. Needless to say, the volumes of the NaCl solution and distilled water added later must be measured with sufficient accuracy to obtain an extract containing 0.85 per cent NaCl. This method of extraction has been found very satisfactory and no further treatment of the extract is required.

Sera—The sera used have been prepared by hyperimmunization of rabbits intravenously with (a) washed suspensions of the elementary bodies of vaccinia [C.L. lapine strain (Craigie and Wishart; 1934, b)], (b) Seitz filtrates of dermal rabbit vaccine containing the LS antigen, and (c) the LS fraction prepared from Seitz filtrates. The LS fraction contains the LS antigen in a purer state than Seitz filtrates (Craigie and Wishart; 1936, b). These preparations, if unheated, contain both antigens and stimulate the production of both L and S antibodies. Rabbits, however, vary in respect of the relative amounts of L and S antibodies which they develop so that it has been possible to select sera which in certain dilutions contain only L antibody in sufficient amount to fix complement with the LS antigen and do not fix complement with heated (i.e., S) antigen. Such sera were used for the titration of L antigen. S sera for the titration of S antigen were obtained by hyperimmunization with antigen preparations heated for one hour at 70°C. The sera were heated at 56°C. for 45 minutes after separation from the clot and stored without preservative. Before being used for variola tests, they were titrated with Seitz filtrates of lapine (a) unheated and (b) heated for one hour at 70°C. L sera do not fix complement with heated antigen while S sera fix complement with both heated and unheated antigens. A series of dilutions of the sera was tested with a series of dilutions of the antigens extending beyond the limit of their titre. Since serum pre-zones may be encountered in this reaction the serum was subsequently used in that concentration with which the antigen gave complete fixation in its highest dilution.

Complement-fixation Test—The scheme used was that previously employed for vaccinia (Craigie and Wishart; 1934, a) and is set out in table I.

The complement used was guinea-pig serum dried from the frozen state. It will be noted that in the controls of the test, special controls were included in order to ascertain whether the complement in the dilutions used in the test retained its estimated number of minimum haemolytic doses during the period of cold-room fixation. Cold-room fixation is essential in order to obtain sensitivity. Reduction in amount of cells and complement used in order to increase the sensitivity of the test is not only inadvisable but unnecessary. The scheme provides a very sensitive test yielding unequivocal results.

TABLE I

SCHEME FOR THE VACCINIA-VARIOLA COMPLEMENT-FIXATION TEST

Test

(a) Antigen, serial dilutions 0.2 cc.
 (b) Complement: 3 M.H.D. in 0.2 cc. 0.2 cc.
 (c) Serum, constant dilution 0.1 cc.

Controls

(1) Antigen; serial dilutions as in (a) 0.2 cc.
 Complement: 1.5 M.H.D. in 0.2 cc. 0.2 cc.
 Saline 0.1 cc.
 (2) Complement: 3 M.H.D. in 0.2 cc. 1 in 3
 and following volumes distributed:

Tube	1	2	3	4	5	6	7	8
Diluted Comp. dil. 1 in 3	0.4	0.3	0.2	0.15	0.4	0.3	0.2	0.15 cc.
Saline	0.1	0.2	0.3	0.35	....	0.1	0.2	0.25 cc.
Serum, constant dil. as in (c) .....	....	....	....	....	0.1	0.1	0.1	0.1 cc.
Estimated M.H.D. of complement present	2	1.5	1	0.75	2	1.5	1	0.75 M.H.D.

Test and controls kept in cold room overnight 16 to 18 hours; then after standing at room temperature for 30 minutes, the haemolytic system is added. This consists of a 5 per cent suspension of washed sheep cells sensitized with 5 minimum sensitizing doses of amboceptor. 0.25 cc. of the cell suspension is added to each tube. The tests are read after incubation for 30 minutes at 37°C.

The Role of L and S Antigens in the Variola Complement-fixation Reaction

Experiments carried out with vaccinia filtrates and variola crust extracts have shown that both the L and S antigens are involved in the complement-fixation reaction. As table II shows, fixation of complement is abolished if the filtrate or extract is heated at 70°C. and tested with L serum. The heated extract, however, retains its ability to fix complement with S serum.

This phenomenon indicates a danger of false negative reactions in the application of the reaction to variola if a serum in which L antibody predominates is employed. This will be avoided if the serum is used in a concentration which will give fixation with the stable S antigen. The L antigen is liable to deteriorate through remaining moist and being subjected to too high a temperature during transit.

Table III shows the results obtained when a number of variola specimens were examined with L and S sera in order to determine the relative amounts of L and S antigens present. While the majority of the specimens show the usual relationship of the L and S antigens, specimens T27 and V5 showed a relative deficiency of L antigen, emphasizing the importance of employing serum in the test in a concentration known to give fixation with the stable S antigen. Specimen V6 was obtained from a case modified by vaccination seventeen years previously. T specimens (table III) were from cases of smallpox major and A specimens from smallpox minor. These crust specimens were about

TABLE II

Test Sera	Variola Antigen Dilutions ¹									Antigen
	1/250	1/500	1/1000	1/2000	1/4000	1/8000	1/16000	1/32000	1/64000	
L serum	.	.	4	4	4	4	1	.	.	N
	0	0	0	0	0	0	.	.	.	H Variola Crust
S serum	.	.	.	4	4	4	4	2	0	N Extract No. 31
	.	.	.	4	4	4	4	2	0	H
L serum	.	.	4	4	4	4	2	0	.	N
	0	0	0	0	0	0	.	.	.	H Variola Crust
S serum	.	.	.	4	4	4	4	2	0	N Extract No. 70
	.	.	.	4	4	4	4	2	0	H
	Vaccinia Antigen Dilutions ²									Vaccinia
	1/200	1/400	1/800	1/1600	1/3200	1/6400	1/12800			
L serum	.	4	4	4	4	2	tr			N
	1	0	0	0	0	0	.			H Vaccinia Seitz
S serum	.	4	4	4	4	3	tr			N Filtrate No. 330
	.	4	4	4	4	3	0			H

N—Unheated antigen.

H—Antigen heated 1 hour at 70°C.

4—No haemolysis.

0—Complete haemolysis.

3, 2 and 1—Intermediate degrees of haemolysis.

All controls satisfactory.

¹Dilutions based on dry weight of crusts.²Dilutions of Seitz filtrate of lapine.TABLE III
COMPLEMENT-FIXING ACTIVITY OF VARIOLA CRUSTS WITH L AND S SERA

Reference number of specimen	Highest dilution* of crust extract giving complete fixation	
	L Serum	S Serum
T27	negative 1 in 1,000	4,000
T30	1 in 1,000	4,000
T31	8,000	16,000
A59	16,000	32,000
A61	8,000	8,000
A65	4,000	2,000
A70	8,000	16,000
A83	2,000	4,000
V2	17,500	35,000
V3	2,000	8,000
V4	600	1,200
V5†	negative 1 in 5‡	80‡
V5 (swab)	1 in 5‡	80‡
V6†	80‡	160‡

*Dilution is referred to dry weight of crusts unless otherwise indicated and is the final dilution of the antigen in the 0.5 cc. volume of antigen, complement and serum mixture.

†Dried tops and fluid from six pustules.

‡Dilution refers to extract of dried material in a volume of 2 cc.

seven years old when submitted to the above tests, having been kept in the dry state. V specimens were from recent cases.

A 1 in 50 dilution of crust extract from A59 was used in a corneal and normal and immune rabbit test (McKinnon and Defries; 1928) with negative results. It will be noted that complement-fixation was positive in a dilution 600 times as great as employed in the above tests. In addition to the greatly superior sensitivity of the complement-fixation test, the antigens necessary for the reaction withstand relatively harsh treatment.

Relative Sensitivity of the Precipitin (Flocculation) and Complement-Fixation Reactions

Tests were carried out to compare the relative sensitivity of the flocculation test (Burgess, Craigie and Tulloch, 1929; Craigie and Tulloch, 1931) and the complement-fixation test from a diagnostic point of view. Extracts of variola crusts and vaccinia preparations were subjected to both tests and the highest dilutions giving (a) complete fixation with 3 M.H.D. of complement and (b) sufficiently definite precipitation to permit of a positive report were ascertained. On this basis it appears that the complement-fixation reaction is 8 to 12 times more sensitive than the flocculation reaction.

Collection of Material for the Variola Complement-fixation Test

With regard to the diagnostic application of the test, answers are necessary to several questions relating to the collection of the material which is to be examined. It is important to know whether desiccation of the material reduces the amount of soluble antigen which may be recovered. Since the use of 8.5 per cent NaCl permits of practically complete extraction of the stable S antigen, drying of the material involves no risk of a false negative reaction due to failure to obtain a solution of the specific antigens, provided that the reaction of the extracting fluid is not more acid than pH 6.5. Indeed, rapid drying is advisable in order to prevent bacterial growth in the specimen. The date on which the material is collected from the focal lesion of variola appears to be unimportant since the antigens of variola are present in the early vesicle and persist in the dried crust. These antigens are probably present in considerable amount in the papule which precedes the vesicle since they can readily be demonstrated in the papular stage of vaccinia in the rabbit. Measurement of the amount of material submitted for the test and determination of the minimum amount which will give a positive reaction in the test are important. As far as crusts are concerned, these may be weighed and the dilutions tested based on their dry weight. Of eleven weighed specimens of variola crusts examined, all fixed complement with S serum in dilutions at least as high as 1 in 1,200 (table III). When the eruption is in the vesicular or pustular stage, the physician may encounter difficulty in collecting the fluid properly in capillary tubes and may prefer to collect it on diphtheria swabs or on the wall of a sterile tube. When collecting by the latter method, the rim of the tube is placed on the skin over the punctured vesicles and the fluid collected by moving the tube laterally over it.

The tube is then rotated to spread the fluid over the wall and thus facilitate drying. After drying it should be plugged with a cotton wool plug and not corked.

Fluid collected in either of these ways cannot be measured by weight or volume. It was thought that it might be referred to the size and number of vesicles from which the fluid was collected, but we have been unable to obtain a sufficient number of specimens of variola vesicle fluid to investigate this. It will be noted (table III) that specimens V5 and V6, each representing dried fluid from six pustules, gave complete fixation in a dilution of 1 in 80 and 1 in 160 respectively of the 2 cc. volume of fluid in which they were extracted.

In order to arrive indirectly at some idea of how little variola vesicle fluid might be expected to give complete fixation with the technique used, a comparison was made of the complement-fixing activity of vaccinia vesicle fluid and crusts from the rabbit. Swabs from single vesicles were extracted in 3 cc. volumes (0.3 cc. 8.5 per cent NaCl + 2.7 cc. distilled water). These extracts gave complete fixation in a dilution of at least 1 in 8. Other vesicles were allowed to crust and the crusts gave complete fixation in a dilution of 1 in 8,000 (referred to dry weight). All variola crusts examined have given complete fixation in dilutions at least as high as 1 in 1,200 (table III), and it is therefore probable that in most cases fluid from a single vesicle of variola, 4 mm. in diameter, would be sufficient to give a positive reaction. We would suggest, however, that fluid be collected from at least six vesicles for the test, and that as much fluid as possible be obtained from each vesicle. Although the test is a delicate one there are obvious limits to its sensitivity.

A further question relates to the cleansing of the skin prior to collection of vesicle fluid. Vesicle fluid and crust extracts usually show very little anticomplementary activity but previous application of medicaments to the lesion may result in the extracts being too anticomplementary for the test. It is suggested that the lesions be cleansed with water and then with ether before the fluid is collected. Ether is devoid of any deleterious effect on the LS antigens.

Table IV summarizes the results obtained with the scheme for the variola complement-fixation test described in this paper. The number of specimens of variola and chickenpox examined in this series is small and therefore may seem

TABLE IV
SUMMARY OF RESULTS WITH THE VARIOLA COMPLEMENT-FIXATION REACTION

	Variola Specimens	Chickenpox Specimens		
	Positive	Negative	Positive	Negative
Dried Fluid	2	0	0	6
Crusts	13	0	0	7

Additional Specimens:

- 1 Chickenpox—anticomplementary.
- 1 Smallpox (?)—anticomplementary (ointment applied to lesions).
- 1 Haemorrhagic chickenpox (?)—negative.
- 1 Impetigo—negative.

to carry little weight as evidence of the specificity of the test. They should, however, be considered in the light of the evidence advanced by Gordon (1925), Parker and Muckenfuss (1933) who applied the complement-fixation reaction, and Craigie and Tulloch (1931) who applied the flocculation reaction, to variola and control specimens. The antigens of variola and vaccinia to which the test is directed are specific for these viruses, as far as present knowledge goes, and certainly do not occur in chickenpox. Negative results with variolous material will be avoided by submission of an adequate amount of material and the use of an S serum.

Preparation of Antivaccinia Serum—As Parker and Muckenfuss's experience with fluid from a case of impetigo shows, a false positive result is possible if the fluid is grossly contaminated with microorganisms and the serum has been prepared from vaccine containing bacteria. Rabbit dermal vaccine, unless precautions are taken, may be grossly infected with bacteria and such vaccine cannot be used for the preparation of hyperimmune sera for the variola complement-fixation test since antibodies to the bacteria will be developed. The possibility of fixation of complement referable to secondary infectors may be eliminated by the use of vaccine virus propagated in the testes of the rabbit or some other method yielding virus free from contamination. Potent pure S antivaccinia sera may be prepared by hyperimmunizing rabbits with antigen preparations, heated for 1 hour at 70°C. (Wishart and Craigie, 1936). The simplest method of preparing antivaccinia serum for use in the test is theoretically open to the objection just mentioned, but we believe that with proper precautions the risk of significant amounts of bacterial antibodies in the serum obtained is negligible. This method employs third-day dermal vaccine such as is used for the preparation of elementary body suspensions (Craigie and Wishart; 1934, b). The seed virus should be bacteriologically sterile and if the skin is thoroughly cleansed with alcohol and acetone prior to inoculation and with ether prior to harvesting of the pulp, secondary infectors will be practically eliminated. The virus used should be a suitable strain which has been adapted to the skin of the rabbit and the methods of inoculation and harvesting described by Craigie and Wishart (1934, b) should be followed. For this purpose, however, buffered saline, pH 7.0, is preferable to dilute buffer. The pulp suspension should be centrifuged at high speed for twenty minutes and the supernatant immediately filtered through a Seitz EK filter. Rabbits immunized at least three weeks previously by intradermal vaccination are given the filtrate intravenously at five-day intervals, injections of 0.25 cc., 0.5 cc., 1 cc., and 1 cc. being given. The serum should be tested five days after the last injection and the animal bled out the following day if the serum is sufficiently active. Several rabbits should be inoculated since the degree of response is variable. The serum is tested with a vaccinia Seitz filtrate which has been heated for one hour at 70°C. as well as with unheated filtrate in order to obtain its S titre as well as its total titre. Serial dilutions of serum as well as filtrate are, of course, required if the titres of both are unknown. The serum is subsequently used in the concentration which gives complete fixation with the highest dilution

of test antigen capable of giving complete fixation. This concentration should be verified with an extract of variola crusts. Sera which show a marked difference in their titres for unheated and heated filtrates (i.e., more than 8 to 1) should not be used since this indicates a proportionately high L titre and zoning may be encountered in extended tests with vaccinia. Alternatively the filtrate may be heated at 56°C. for 1 hour prior to injection in order to inactivate the L antigen. Heating to 70°C. will prevent L antibody formation but filtrates heated to this temperature may cause death on intravenous injection.

SUMMARY AND CONCLUSIONS

A scheme for a sensitive complement-fixation reaction in variola is described. In this test, vesicle or pustule fluid or crusts are tested for the specific antigens of the virus, by means of antivaccinia serum. One of the antigens involved in the reaction is labile and it is therefore important to use a serum which will detect the stable S antigen. The test is eight to ten times more sensitive than the flocculation test and better adapted for use in routine laboratories, since no elaborate manipulation of the material submitted for test is required. From a consideration of the results obtained with this test and with the flocculation reaction it is suggested that 0.008 gm. of clean crusts or the total contents of six vesicles or pustules from a case of variola will provide sufficient material for identification. In many cases of variola positive fixation will probably be obtained with lesser amounts of material but under these circumstances a negative result should be reported as insufficient material and a further specimen requested. If this is not available and vaccination has not been performed, the patient's serum may be tested for antibodies, using a previously tested vaccinia filtrate or smallpox extract as test antigen.

REFERENCES

Jobling, J. W.: (1906) *J. Exper. Med.*, **8**: 707.
Sugai, T.: (1909) *Centralbl. f. Bakt., Abt. I, Orig.*, **49**: 650.
Parker, R. F., and Muckenfuss, R. S.: (1933) *J. Infect. Dis.*, **53**: 44.
Gordon, M. H.: (1925) *Sp. Rep. Ser., Med. Res. Coun., Lond.*, No. 98.
Bedson, S. P., and Bland, J. O. W.: (1929) *Br. J. Exper. Path.*, **10**: 393.
Schultz, E. W., Bullock, L. T., and Lawrence, F.: (1928) *J. Immunol.*, **15**: 243.
Thompson, R., Hazen, E., and Buchbinder, L.: (1932) *J. Immunol.*, **22**: 189.
Gilmore, E. St. G.: (1931) *Br. J. Exper. Path.*, **12**: 165.
Craigie, J., and Wishart, F. O.: (1934, a) *Trans. Roy. Soc. Canada*, **28**, Sec. V, 91;
(1934, b) *Br. J. Exper. Path.*, **15**: 390; (1936, a) *J. Exper. Med.*, in press; (1936, b)
J. Exper. Med., in press.
McKinnon, N. E., and Defries, R. D.: (1928) *Am. J. Hyg.*, **8**: 93, 107.
Burgess, W. L., Craigie, J., and Tulloch, W. J.: (1929) *Sp. Rep. Ser., Med. Res. Coun.,*
Lond., No. 143.
Craigie, J., and Tulloch, W. J.: (1931) *Sp. Rep. Ser., Med. Res. Coun., Lond.*, No. 158.
Wishart, F. O., and Craigie, J.: (1936) *J. Exper. Med.*, in press.

Progress in Public Health in Canada*

C. G. POWER, M.C., B.A., L.L.B.

Minister of Pensions and National Health, Canada

YOU will, I am sure, understand that it was with considerable reluctance that I, a layman, accepted the extremely kind and flattering invitation of the Minister of Health for the Province of Ontario, my good friend the Honourable Dr. Faulkner, to attend this evening's reunion, and I was more embarrassed than I can say when, later on, he expressed the wish that I should address an audience composed of several hundred members of the medical profession, all of whom were by training and experience experts in public health.

I freely confess that prior to my appointment as Minister of Health, I had little or no experience in matters of this kind. Shortly after, I settled down to study this problem and found its history full of fascination, glamour and romance. I found that controllable diseases, plagues, pests and epidemics, had killed more people than all the wars since the world began; that although the nomenclature, public health, was of comparatively recent origin, there had been exponents of the art almost since the world began; and that even long before the dawn of Christianity, the ancient Greeks and Romans, through their civic sewage and drainage system such as are now being exposed in the ruins of Pompei, through their system of baths whereby every citizen could and did bathe every day of his life, were perhaps further advanced than we so-called modern civilized people are in our city slums of to-day: that there were down through the years, and particularly in the last century and a half, heroes and heroines in the battle of science as great as those whose names are emblazoned across the pages of history. That if France had its Napoleon, and England its Wellington, so too there was the Gallic Pasteur and the Saxon Lister. That there were great noblemen in England, the Dukes of Norfolk and the Earls of Shaftsbury, masters of diplomacy and statescraft, who strode like giants amidst the blaze of trumpets, in the brilliance of courts, the luxury of St. James's and Buckingham, but there was a Howard, the greatest of them all whose reforms were directed against the disease, the foulness and the degradation of the hells which in those days were called prisons, and there was an Ashley, son of an equally honoured name, who strove not against kings, princes and statesmen, but against greed, avarice, Victorian inertia, to bring about humane legislation for miners and their children. That though the headlines of thirty-odd years ago were given to a Teddy Roosevelt for his charge on San Juan Hill, and to a Dewey for the thundering of his guns in Manila Bay, yet after all the unsung heroes of the Spanish-American war were not those who earned the encomiums of the mob but the Reids, the Carrels, and Lazear, who voluntarily allowed themselves to be inoculated through the bites of mosquitoes in order to prove

*Presented at the Twenty-second Annual Meeting of the Ontario Health Officers' Association, Toronto, May, 1936.

to humanity that the loathsome and almost inevitably deadly yellow fever plague could be overcome by human science.

I next turned to our own country and very naturally, having been born and bred within the shadow of Cape Diamond, and in the city which is the cradle of Canadian nationality, inquired into the early story of the pioneers of other days, and it struck me that altogether apart from the hardship incidental to the exploration, the constant dread of English and Dutch enemies, and their savage Indian allies, the peril which natural conditions presented in a country of the most severe climatic conditions, there was also in the early days of our Canadian history, the almost constant recurrence of disease, pest, plague and epidemic; and that courageously as becomes pioneers, the early settlers of New France, without scientific guidance, without knowledge, without training, set out to battle with the scourges which menaced them. That the first indication of interest in pure food which you find in Canadian history goes away back to 1667 when meetings were held in the City of Quebec to consider the quality and weight of bread; and in the year 1707, regulations were passed for the inspection of meat. Under the latter, no butcher was permitted to kill an animal without first having informed the King's Officer or his representative of his intention to do so. It was the duty of this officer to ascertain if the animal was in a healthy condition and no one was permitted to sell meat in the town without presenting to the proper authority a certificate duly signed by a judge or in his absence a seigneur, or a parish priest.

Nearly two hundred years afterwards it took the genius of a great American author to point out to the millions of people of his own country that the stockyards of one of the greatest American industrial cities must be controlled by some such form of inspection if the public health of the United States of America and Canada too was not to be seriously jeopardized.

About the same time laws were enacted apertaining to the cleanliness of streets and houses. In those days civic authorities had powers which probably a great many of you envy to-day. They could enter without warrant into any dwelling in order to ascertain if it was maintained in a clean and sanitary condition.

Even child welfare was looked upon as the duty of the State, for we learn that orphaned and homeless children and those of whom we to-day speak as under-privileged, were made wards of the King and money was set aside for their care until the age of 18 years, when they were taught farming and trades.

The infant colony even produced in Dr. Michael Sarrazin, a member and correspondent of the Royal Academy of Science of France, a physician who is said to have successfully operated on cancer, and who was capable of giving advice on public health matters in so far as the knowledge of the day went.

Whether on account of the colonization activities of the Government, or otherwise, vital statistics were kept in New France long before it became the custom to do so in the Old Country, and fifty years before Captain John Gaunt compiled mortality statistics of the great City of London, the priests of Quebec made and compiled annual reports of births, marriages and deaths.

The story of epidemics in New France is a continuous record of human suffering. From the time of their arrival in the country, the French suffered

repeatedly from epidemics of smallpox which proved to be a veritable scourge. The disease was transmitted to the Indians and as early as 1653 it appeared among the Montaganais, who dwelt on the Lower St. Lawrence; spreading rapidly, it invaded in turn various tribes from the Atlantic to the Great Lakes, and from James Bay to the Southern Seaboard. Whole tribes were exterminated. In an endeavour to relieve the suffering of the Indians, the Hotel Dieu Hospital was opened in Quebec by the nuns in the year 1639. Mention of the Hotel Dieu recalls to our minds, I am sure, the sacrifice, the unselfishness of those gently nurtured women who, coming from what was then the most highly civilized country, containing the most luxurious homes in all Europe, faced danger, hardship, privation and death, in order to bring to unknown peoples of a different character, different habits, different upbringing, the blessings of education and Christianity, and to found here hospitals to care for savages who understood neither their manners, their language, their ideas, and in many instances were not even grateful for the kindnesses so lavishly and unselfishly bestowed upon them. Women like Jeanne Mance of the Hotel Dieu Hospital in Montreal; Marguerite Bourgeois and Marie d'Incarnation, stand out amongst the real founders of public health in this country. Priests and missionaries too, the early Jesuits and Recollets were instructed in the use of the rude medicaments of the day, and in rough homespun surgery. In connection with their practice of the salvation of souls, they were taught the healing of bodies, and many an Indian warrior, in spite of the expression of his stoic wooden countenance, was relieved of pain and suffering.

The wars that were waged so frequently between New England and New France brought an influx of troops from France each year and often their arrival was accompanied by outbreaks of contagious diseases. Frequently the colony was devastated by these diseases, of which smallpox was the most common. On occasion, it served to save the country from the English. You will recall that in 1690, the New Englanders set about conquering New France. Having captured Acadia, they planned to attack Montreal and Quebec simultaneously, sending 2,000 New England troops and 1,500 Indians overland by way of Lake Champlain, while Phips planned to attack Quebec from the St. Lawrence. Smallpox broke out among the overland troops while on the march, five hundred being affected, and among Phips's forces while engaged in attacking Quebec. On their return to Boston, Phips's men infected the inhabitants and an extensive epidemic occurred in that city.

It is believed that some of the epidemics which occurred from time to time were due to plague and that those of the years 1710, 1718 and 1740 were of that nature. Moreover, there is no doubt that cases of plague did find their way into Canada and were treated in the Quebec hospitals. It is also claimed that yellow fever, which in those days was known as "Mal de Siam", was brought into the country by ships from the West Indies.

The first quarantine enactment, the object of which was the prevention of the introduction of plague, was passed by De Vaudreuil, the Governor, and Begon, the Intendant, in the year 1721. Plague was epidemic in Marseilles in the preceding year, 30,000 people having died in that city and, as a considerable number of vessels passed back and forth between Quebec and Mediterranean

ports, it was thought advisable to take every precaution to prevent its entry into the country. It was enacted that captains or masters of vessels, barks or brigantines, from all Mediterranean ports, should anchor in the stream off Isle aux Coudres in the St. Lawrence, where they should fire a cannon or swivel-gun at intervals of a quarter of an hour apart to announce their arrival. It was forbidden to send small boats ashore or to permit any member of the crew or passengers to disembark and communicate with any inhabitant of the colony. Corporal punishment was provided for the captain, master or others who went ashore. It was strictly forbidden to discharge cargo and any such cargo found on shore was ordered to be burned on the spot where found, without formality or judicial procedure.

Although this was the first official quarantine enactment, it had been customary prior to that for physicians to board and detain vessels in the river at Quebec to examine the passengers and crew, if diseases were reported on board, and on one occasion a war vessel called the "Leopard" was found to be so infected with disease that the military authorities set fire to it and let it founder in the port of Quebec. This was not quite so drastic a measure as was taken by Chinese in British Columbia to prevent the spread of leprosy. On April 1, 1882, a leprous Chinese was hanged and partly burned by his countrymen at New Westminster, B.C., with the idea of preventing contagion.

There is no available information regarding the measures that were adopted in those days to prevent the spread of contagious diseases, nor is there any evidence to indicate that isolation and segregation of the sick and contacts were carried out.

Owing to the disturbed state of the country during the years following the conquest, records of disease were only indifferently kept and there is very little information available to help us in forming an opinion as to its prevalence other than references to outbreaks of smallpox. It is unfortunate that no records were kept of the minor infectious diseases, but this was because many of them were not clearly differentiated clinically, also because of the fact that under the French regime it was illegal to state the cause of death on a death certificate. It was feared that, in some instances, offspring of deceased persons might be stigmatized as, for example, in cases of death from insanity. If the facts were known, it would probably be found that deaths from diphtheria, scarlet fever, typhoid, and tuberculosis were more numerous than those from smallpox, typhus, and plague. The introduction of vaccination in 1802 and the establishment of a vaccine institute in the city of Quebec in 1821 helped very materially to reduce the incidence of smallpox and, from that time onward, epidemics were less frequent.

Cholera epidemics occurred in Canada in the years 1832, 1834, 1849, 1851, 1852, and 1854. The Imperial authorities advised the Executive in Lower Canada in 1831 that cholera was epidemic in England and suggested that, in view of the large amount of immigration from England, steps should be taken to prevent its entrance into the country. On receipt of this information, the Bishop sent a circular letter to the clergy of the province suggesting that they advise their parishioners not to visit vessels moored in their vicinity and to take up with their official representatives the adoption of measures to prevent crews of

vessels from landing until they had been visited by the sanitary authorities. A sanitary committee was appointed in the city of Quebec and a quarantine station was established at Grosse Isle in the St. Lawrence in 1822 and placed under military authority.

In spite of these precautions, the disease found its way into the country with what disastrous results you are all aware. During each of the succeeding epidemics of cholera, quarantine and other measures were ineffective. The presence of cholera in the country to-day would cause little concern and would not spread widely, owing to the fact that the majority of cities and towns filter or chlorinate their water supplies. As an indication of the lack of sanitary facilities in those days, we read that during the cholera epidemic of 1854 in the city of Saint John, N.B., where 1,500 people died, the sanitary conditions were very bad and that large numbers of people were crowded together in lanes and alleyways and no provision was made for getting rid of the filth which such crowded conditions brought about. The water supply was very imperfect, most of it being obtained from wells. There were no sewers worthy of the name and no system of sewerage had even been dreamed of. The epidemic of 1849 was very widespread. It is stated that many of the forty-niners died from the disease while on their way to the gold fields of California.

In 1847 typhus fever was introduced into the country, 20,000 immigrants dying in that year alone, a large number of whom were immigrants from the Emerald Isle, fleeing from the ravages of the potato famine in their own country, only to be crowded into ships like cattle to die of the deadly ship fever. Thousands of them filled with hope, energy and ambition to found homes in the new country were cast into unknown graves at Grosse Isle and Point St. Charles, Montreal.

Under present day conditions, of course, such a calamity, amounting almost to a catastrophe, could not have occurred, because we have now learned to deal with, overcome and to conquer the epidemic diseases of those days such as cholera, typhus and plague, but may I pause here to remark that even to-day, with all our boastful advances in science, in health, and in Government, we are obliged to admit that 30,000 Canadian citizens died during the influenza epidemic of 1918.

The creation of Provincial Boards of Health beginning with that of Ontario in 1882, followed by that of Quebec in 1885 and of every other Province of the Dominion until that of Prince Edward Island in 1927, and the Department of National Health of the Dominion of Canada in 1919, shows clearly that at last the citizens of this country are taking an interest in what is probably the greatest and most important problem they have before them, namely, the conservation, the preservation of the natural energies of a virile, energetic nation.

There are difficulties, financial, sectional, constitutional, in the way of a fuller development of the task to which we have set our hand, but with public spirit awakened, public opinion stirred by means of voluntary organizations, through the work of outstanding physicians, scientists and laymen, we may hope as soon as the country returns to its normal activities that a newer and better day will dawn for all those to whom a foremost consideration is the making of Canada a better, healthier country to live in.

Methods of Teaching Psychiatric Nursing and Mental Hygiene*

E. R. DICK, REG.N.[†]

Assistant Inspector of Training Schools for Nurses, Division of Nurse Registration, Department of Health of Ontario, Toronto

NURSING, viewed in its true perspective, is a part of a great social force which is attempting to meet the needs of human beings. As nurses, we hope that we are learning to detect the needs of the individual and to act accordingly. How is this possible if the nurse has not the requisite knowledge and understanding of human nature to lend her insight? Is she fitted for the task of helping and teaching if she has not a comprehensive conception of man as an indivisible unit; of the significance of early environmental influences; of individual differences; of the intricacies of individual adjustment to the varied problems of life; and of the rudiments of a well-balanced plan for living?

Miss Effie J. Taylor, Dean of Yale University School of Nursing, has said:

"An understanding of mental hygiene principles is one of the basic necessities in nursing, as it is in any type of work that involves personal and social relationships. We want and need the knowledge in order that nurses may do a better and more efficient nursing job."

Dr. Esther L. Richards, Associate Professor of Psychiatry, Johns Hopkins University, when speaking to the Visiting Nurse Association of Chicago several years ago, said:

"Surely there is not a richer opportunity for utilizing the principles of mental hygiene than in this sphere of service. From what I have seen of the nurse-in-training and the nurse in public health, I believe that she is not only competent to understand and use these principles dealing with the relation of behaviour to health, but I feel that her work is seriously handicapped by a lack of training in this branch of medical science. To make possible such practical experience for you, who go out and bear the burden and heat of the day, should be one of the greatest causes to which nursing education can direct its energy."

The principles and practical applications of mental hygiene must of course be an integral part of the curriculum of any school of nursing. However, the student should have some further experience in a psychiatric clinic—not only to become skilled in nursing mental illness, but because of the preventive aspects, or, if you like, the mental hygiene aspects. Just as we think there is a close relationship between mental hygiene and clinical psychiatry, so we think there is a close relationship for the nurse between mental hygiene and psychiatric nursing.

*Presented before the Mental Hygiene Section at the Twenty-fourth Annual Meeting of the Canadian Public Health Association, Toronto, June, 1935.

[†]Formerly Director of Nursing, Toronto Psychiatric Hospital.

NURSING GROUPS RECEIVING INSTRUCTION

Before discussing in some detail methods which are used in the Toronto Psychiatric Hospital to teach mental hygiene, it is necessary to state that several groups of nurses come to this hospital for instruction and practice. The following schools of nursing allow one or more third and second year student-nurses to elect to come to the Toronto Psychiatric Hospital for three months: Toronto General Hospital, Hospital for Sick Children, Toronto Western Hospital, Grace Hospital, Women's College Hospital, and the Brantford General Hospital. This program is continuous throughout the year, about thirteen undergraduates being in attendance at once. There are also undergraduates from the University of Toronto School of Nursing, seven being in attendance in 1935. In September and March of each year, six graduate nurses begin a six-months' post-graduate course in psychiatric nursing.

The description of some of the content of courses and the methods of teaching which follow refers to both the undergraduate and the post-graduate courses.

UNDERGRADUATE AND POST-GRADUATE COURSES

An attempt is made to apply the principles of mental hygiene in the carrying out of the student program. It is generally recognized that a course in psychiatric nursing is an opportunity for the student to benefit in respect to her own mental health. It is brought to her attention at the beginning of her course. It is suggested to her that she may gain more insight into her own behaviour; that she will shortly observe that some outstanding psychotic symptoms appear to be simply exaggerations of tendencies to which many of us may lay claim, and that according to new insight gained, it may be possible to modify some of our potentially unhealthy tendencies. The inter-relationship of mental and physical health is stressed to lend the student further insight into her own behaviour. She is asked: Is it possible to have a physical disability, no matter how minor, without a corresponding mental disability? Is she capable of the same performance, is her equanimity threshold the same, does she feel as optimistic as usual in the presence of the common headache?

The permanent nursing staff of the hospital has been carefully planned to secure for the student an uninterrupted teaching program, and also to permit the student to be introduced gradually to her new responsibilities. In all fairness to the new student, who is adapting herself to the new situation, this seems one of the fundamentals to be observed. Each member of the permanent staff has been asked to consider herself a teacher in the sense that the inexperienced student needs much help from her. Because of this permanent staff who are competent in the care of mental patients, it is possible to give the student a just amount of responsibility. Her experience need not suffer as a consequence. To illustrate this point: A group of patients who go walking may be accompanied by one or two students, for whom we wish this experience and who will be of great assistance during the walk, but a graduate nurse will also be present,

and it is she who will accept the responsibility of the group. Further, the permanent staff makes it possible to provide an orientation period of three days to facilitate the student's adjustment. It provides for short periods on the ward during which she has a very few well-planned assignments, is shown the plan of the ward, has explained the routine procedures, and hears discussed the conditions of the patients. It also provides for a tour of the hospital, several hours of introductory classes, and a conference or ward clinic.

In a group lecture, problems of personal adjustments are discussed. Emphasis is placed on the advisability of the nurse, who is constantly helping others, to make a real effort to adjust herself adequately; to recognize that her present habits of reaction have been learned throughout the previous years of her life; to realize that "within certain limits the average man and woman of either an ingrowing or outgrowing personality can develop into an individual reasonably adjusted to the circumstances of life—both from his own standpoint, and that of his fellow beings." A few of the means of acquiring a certain degree of mental health are mentioned, physical health being one of them. Occasionally we ask the student to put on paper her interpretation of adequate mental health. This is not a particularly valuable assignment, but at times one does become curious as to what these young students think about mental health. The following statements are of interest:

"An individual who enjoys mental health is able to adapt himself to any situation without deviating to any great extent from his normal behaviour. He is able to work and play successfully and happily with the other people with whom he comes in contact, and is able to live with himself, to be contented, to have his aims and ideals, and as a result, make his contribution to the community."

"Mental health is that state of mind which enables one to adjust to changing situations satisfactorily, both for himself and for his fellow-men. If he has that state of mind he is happy and contented [and here this student seems dubious] at least three-quarters of the time."

A final word about the attempts to apply the principles of mental hygiene in the student program. This effort is not organized, but, it is hoped, is a concerted one. All criticism is couched carefully in constructive terms. If interest and initiative seem to be lacking, the student is asked for an explanation. Does she feel well? Is she sleeping well? Is she worrying about some personal problem? Is she having some difficulty in her work with which she needs help? Any opportunity to chat informally with an individual student is eagerly seized by the teaching staff. Thus an attempt is made to estimate how much help the individual nurse needs, and how much benefit she is deriving from her experience here.

Ward Visits

Valuable practice periods are spent on the wards. Stress is laid on the nurse's attitude toward the new patient. The patient is a stranger in one sense, yet not in another. As he walks in the ward door one knows that this personality for the most part represents his original constitutional endowment, plus all his

past experiences. He has lately been a member of a family group, an interesting member of society, but because of this incident of illness has had to come to hospital for treatment.

Briefly the steps in treatment following admission are: a physical and mental examination; a period of close observation, and finally the inception of a treatment program. The importance of the nurse's part during the period of observation is stressed. She is urged to record significant behaviour as she observes it. This additional training in observing objectively is extremely valuable to the student in whatever activities she engages later.

It is assumed in this hospital that the majority of patients will return home to carry on once more. The period of treatment may be considered as a time of rehabilitation. The underlying treatment is the daily program as planned for each individual according to his needs. It resembles the normal day as nearly as possible. Here is one of the most valuable mental hygiene aspects of psychiatric nursing. The nurse helps to plan and assists in carrying out the patient's daily program. It consists of a certain balance of rest and activity. Rest may be sleep or complete relaxation. Activity consists of work and recreation. Work in turn implies a useful, interesting occupation. It may imply also a hobby quite apart from the economic pursuit. Recreation implies active outdoor exercise and diversion. The nurse is interested not only in co-ordinating and supervising this, but is concerned also about his nutrition, elimination, and physical disabilities. It is hoped that the student, at the completion of her course, has grasped, as perhaps never before, the full meaning of a well balanced plan of living.

Here on the ward the student deals with psychotic manifestations. One patient may show temper outbursts, another may be so pre-occupied that his attention cannot be gained, another may have well-fixed delusions of persecution or of self-accusation. Knowing something of her patient's history, the realization comes to her daily that many of these present disabilities might have been prevented by earlier treatment or guidance. It is, of course, a tremendous asset that students have a limited, but sufficient access to the medical case-books. It permits them to study much clinical material in which causal factors which might have been prevented are stressed and discussed. It permits each student also to undertake a nursing study. The personal history is reviewed. Causal factors are picked out. The present illness is described as a marked deviation from the patient's usual behaviour, or rather as an exaggeration of his usual behaviour. The purpose of the case study can best be illustrated by two excerpts from some of the studies. These passages were under the heading, "What I have learned from this patient."

"In doing this case study I have learned perhaps a great deal more about myself than about Mr. D. It has given me a broader knowledge of what seemed to be normal behaviour —a beginning to appreciate people, not according to a set social standard, but as they fit into their environment."

"To have studied such a case is to have learned more about human beings, and also about those people who as "true paranoids" may never be admitted to hospital. What person is there who does not at times misinterpret another's remarks, and how many of us are there

who are sensitive enough to remember, and perhaps even to elaborate on such remarks. Hence, in understanding these people who are mentally ill, one inadvertently comes to a better understanding of oneself. Moreover, one realizes, I think, that more wide-spread education in mental hygiene is imperative, where it is seen as the means of preventing such mental illness."

In the same case study the student includes everything that she thinks she has taught her patient. Throughout she is urged to watch for opportunities to teach health. Just the other day a student discovered that one of her patients had a prejudice against toxoid immunization, although he was the father of a two-year-old child.

Along with the case study is the case method of assignment, by which is meant that the student is responsible for the entire care of one or more patients. Perhaps the greatest contribution that these two methods, case study and case assignment, makes is the emphasis it places on regarding and treating the patient always as a person who is ill at present. When caring for a patient, the nurse needs to be aware of all his needs and attempt to meet them.

Occupational Therapy and Out-patient Departments

Other practice is obtained in the occupational therapy department. Here the student can observe the therapeutic value of a useful and interesting occupation. She realizes that frequently her enthusiasm and interest determine the enthusiasm and interest of her patient. She learns that judicious praise is quite as important for the patient as the first arousing of interests.

Further practice is obtained in the out-patient department. A lecture course is given in which the mental hygiene program in general and behaviour and personality disorders of childhood, are discussed. During the term in this department the student reads case histories illustrating conduct disorders, delinquency, mental deficiency. She observes psychometric tests conducted by the psychologists. She is present at psychiatric and physical examinations, done by a psychiatrist, and at interviews between the social worker and patients. Following supervised visits, the student visits alone. These may be home investigations, or to hospitals, courts, schools, for in-patients and out-patients. Under supervision students arrange occupational, recreational, social adjustments, and general follow-up on in-patients and out-patients. Throughout this practice period, frequent out-patient case conferences are attended, at which co-operating agencies are represented. The student has the opportunity to gauge the importance of a psychiatric out-patient department in the social structure of the community, and certainly all its mental hygiene relationships.

The supervisor of the out-patient department arranges six or more instructive visits during the course. They have to be limited, naturally, but are chosen to give the student a conception of some of the facilities in Toronto to help the maladjusted child. Juvenile court, special classes in the school, vocational schools, the St. George School for Child Study, are some of the visits. Following the visit each student writes her impressions briefly; for example:

"The Bolton Avenue School for Girls and the Junior Vocational School for Boys

take care of adolescent children who are unsuited to the usual academic training given in public schools. They are for boys and girls from thirteen to sixteen years, with an I.Q. ranging from fifty to seventy-five. The boys and girls are trained along vocational lines and fitted to earn their living and take care of themselves after they leave school. They are treated like normal children, but in a guarded environment, and the teachers keep in close touch with the families and try to correct any harmful influence. By giving these children work that they like and are capable of doing well, many behaviour problems of later years are prevented. These children become an asset rather than a liability to the community."

One of the most valuable teaching methods is the regular medical case conference, which the students attend. It becomes apparent what a valuable asset a psychiatric hospital may be in a community, where those who are showing minor maladjustment may come for treatment. It is to be hoped that all the students, when the time comes to leave the hospital, know the true function of a psychiatric hospital.

Another aspect, the realization of which seems an important adjunct to the efforts of any mental hygienist, is the acquisition of a skilful technique in dealing with people. The student has the opportunity to study this technique intensively while in the hospital. On the whole, a mental patient, more than any other, is sensitive to the nurse's approach and attitude. From the beginning, the student learns that she may not expect her patient's co-operation in her treatment unless the patient's confidence is won first. It is interesting to observe how readily some students inspire confidence, and the comparative difficulty another student may have. Establishing this with many different people is not easy, by any means. It is believed, however, that any nurse can become skilled to a certain extent. She learns by experience that a person responds most quickly to the sincere, sympathetic, kind, tactful nurse who can listen as well as talk. She learns also that most people dislike contradiction, argument, sarcasm, moralizing, untruthfulness; that to change a person's viewpoint she must first try to see that person's point of view; and that most people co-operate more readily if suggestions rather than commands are used. These and many more are the lessons the student learns before she may expect to win her patient's confidence and co-operation.

Since these students are potential teachers of the future in whatever field they choose, it seems worth while to help them acquire this skill. If they leave the hospital feeling thus enriched, the cause of mental hygiene will be further advanced.

REFERENCES

Taylor, Effie J.: *Ment. Hyg.*, 16: 264, 1932.
Richards, E. L.: Meaning of Individual Adaptation in the Field of Health. The Visiting Nurse Association of Chicago, 1929, page 11.
Richards, E. L.: Mental Hygiene for Ourselves. The Visiting Nurse Association of Chicago, 1929, page 5.

Staphylococcic Infections of the Bovine Udder*

RONALD GWATKIN, D.V.Sc., and S. HADWEN, D.V.Sc.

Ontario Research Foundation, Toronto

and

H. M. LEGARD, B.V.Sc.

Weston

STAPHYLOCOCCI have been reported by many workers as being capable of producing mastitis. Munch-Peterson (1) cites Bang (1889) and Guillebeau (1890) as having found these organisms as the sole causal agents in certain instances. Wall (2) in 1908 considered that such cases were always acute and might be fatal. Savage (3) described 5 cases, only one of which was clinically severe. He considered proof of the causal relationship was unsatisfactory. F. S. Jones (4) in 1918 found that mastitis from which staphylococci were isolated was usually mild, although a few cases were acute. Minett, Stableforth and Edwards (5) in 1929 describe 6 cases which they classify clinically as subacute or acute. Most of them occurred within the first few days after calving, either during the winter or summer. In some instances it was stated that similar cases had occurred previously in the herd. Two of the six animals died. They consider staphylococcic mastitis of importance because, although apparently less common, cases at times assume a very acute course and may even result fatally. Rosell (6) refers to staphylococci occurring in acute cases of mastitis. Plastridge et al. (7) report that staphylococci were apparently responsible for about 10 per cent of the abnormal udder conditions studied.

We recognize that in the cases which we are reporting there may have been failure to isolate streptococci in some instances, for it is known that the positive cultures may be obtained intermittently, but even allowing for such occurrence, the number of staphylococcus infections is large. Many of these animals were examined several times, always with the same results.

It will be agreed by most workers that we are not in a position to state what constitutes mastitis and where a line may be drawn between normal and abnormal udders. Steck (8) describes extremely slight inflammation resulting from persistent bacterial infections of the udder caused by harmless micrococci and corynebacteria. Some of the cases which we have classified as staphylococcic mastitis were sufficiently slight to be missed by the herdsman, but by our tests there was very definite evidence of infection.

*Presented at the Fourth Annual Christmas Meeting of the Laboratory Section, Canadian Public Health Association, Toronto, December 30, 1935.

METHODS OF DIAGNOSIS

Examination of the udder was made immediately after milking. The milk of individual quarters was tested with bromthymol-blue paper, centrifuged, and the fat removed. The skim milk was set with rennet by Hadley's method (9). Cultures from the sediment were made on the surface of rabbit blood agar plates and Hastings stain was used in preparing smears for microscopical examination. Cultures were examined at 48 hours, subcultures were made, and the organisms identified using the requisite carbohydrates. Good agreement was obtained between the microscopic and cultural examinations which were done independently by the two senior authors. The clinical examinations were made by H. M. LeGard.

SAMPLES EXAMINED

In an examination of the milk of 260 cows, comprising milk from individual quarters of 236 cows in 8 herds, and 24 cows sent in from other herds on account of udder trouble, we diagnosed 143 cases of mastitis. Thirty of these appeared to be due to staphylococci. The rather large number of infections with staphylococci, 21 per cent of the cases of mastitis, is due to the fact that 20 of the 30 cases occurred in 2 herds in which this was the only pathogenic organism found. Table I presents the number and type of cases in the 8 herds.

TABLE I
CASES OF MASTITIS IN 8 HERDS

Herd No.	No. of Cows	Cases of Mastitis	Staphylococcus	Streptococcus	Cause not Determined
1	82	18	1	14	3
2	11	3	—	1	2
3	11	2	—	2	—
4	18	15	14	—	1
5	23	9	2	5	2
6	67	61	—	57	4
7	12	5	3	2	—
8	12	6	6	—	—

Of the 24 unselected cases which were sent in for examination from other herds, 4 were definitely staphylococcus infections, 13 were due to streptococci, 3 to colon bacilli, 1 to *B. pyogenes*, and in 3 the cause was not determined.

The staphylococcus cases are of sufficient interest to be given individual consideration, as they show various forms in which staphylococcal infection of the udder may be manifested.

HERD 1.—One case only was found in 82 cows examined. This was a young cow nearing the end of lactation. Local and general symptoms were severe. The milk was normal by chemical examination at this time but there was a marked increase in leucocytes and the nuclei of the polymorphonuclear cells were ring-shaped in appearance due to the swelling of the cells. In culture an abundant and pure growth of *Staphylococcus aureus* was obtained. This cow freshened 3 months later without any symptoms of mastitis, but examination of the milk again showed an increase in leucocytes and *Staphylococcus aureus* was recovered in pure culture.

HERD 4.—Eighteen cows were being milked in this herd. Fifteen had mastitis.

Twelve of these showed induration in one or more quarters. The milk of all 15 was abnormal by the bromthymol-blue or rennet test, and all showed increased leucocytes. *Staphylococcus aureus* was obtained in culture from 14, either pure or as the predominant organism. From one of these animals a diphtheroid bacillus only was isolated. No streptococci were encountered at that time or on subsequent examinations, cultures always yielding *Staphylococcus aureus*. These cultures all fermented mannitol, although a few mannitol negative strains were isolated from the same cows. An interesting feature in connection with these strains was that the colonies on 9 out of 14 blood agar plates appeared like streptococci at 24 hours while the other plates showed typical staphylococcus colonies. Subcultures of both types on agar slants appeared the same after overnight incubation, and the small colonies themselves eventually attained full size on the blood agar plates. The other 3 cows were classified as suspicious. Clinical examination was negative but 2 showed a large increase and one a marked decrease of leucocytes in the milk, the last animal also having chemically abnormal milk. *Staphylococcus aureus* was isolated from one of these, a diphtheroid from another, and a mannitol and gelatin negative coccus from the last. In other respects this organism resembled the other cocci, producing as much toxin as some of the mannitol positive strains. This herd is a good example of the spread of staphylococcal infection. Fourteen, or possibly 16, out of 18 animals were infected.

HERD 5.—Two cows clinically negative in this herd gave milk which was abnormal by the bromthymol-blue and rennet tests. The milk showed a great increase in polymorphonuclear leucocytes and active phagocytosis of cocci. *Staphylococcus aureus* was recovered from both. These strains fermented mannitol. Re-examinations showed the presence of staphylococci and the absence of streptococci. Four months after the first examination the milk of one cow was much improved, while the milk of the other remained unchanged. *Staphylococcus aureus* was again isolated.

HERD 7.—Three cows were found to be infected with *Staphylococcus aureus*. One showed enlargement only of the left supramammary gland, one had a swollen and indurated quarter, while the other had a slack quarter which gave very little milk. Milk from the affected quarters of all three was abnormal by the rennet test and in the last two also by the bromthymol-blue test. There was a marked increase of leucocytes and cocci were being phagocytized. *Staphylococcus aureus* was recovered several times at short intervals and again 8 months later. These strains fermented mannitol.

HERD 8.—Six of the 12 cows in this herd had one or more quarters infected with *Staphylococcus pyogenes*. Five of the strains were pigmented and one was white. All fermented mannitol. Indurations were detected in only two cows. The milk was normal in appearance and by the bromthymol-blue test, but was abnormal in 4 cases by the rennet test. All showed a marked increase in leucocytes, clumping of the polymorphonuclear cells, and active ingestion of cocci. No streptococci were isolated in the herd.

Unselected Cases

COW NO. 1.—The milk of this cow was normal in appearance but did not coagulate normally with rennet and at times was green by the bromthymol-blue test. The milk was first sent to us for examination because the cream curdled when added to coffee. There was marked increase of leucocytes in all quarters. The polymorphonuclear leucocytes were swollen, the nuclei producing a ring-shaped effect (Fig. 1). A pure culture of *Staphylococcus aureus* was obtained from all quarters in March, April and September. During the summer the udder was treated with acriflavine by the method of Steck (10) without any beneficial effect. Clinical examination in September showed both hind quarters were indurated. History of this animal indicated that the udder had been infected during the previous lactation period. This was the only cow on the premises. Her mother had been affected with mastitis and these animals had been together before this one was brought to the farm.

COW NO. 2.—This case was diagnosed as probably staphylococcal by the owner of

no. 1, a veterinarian. The milk was normal in appearance and by chemical tests, but microscopic examination showed a marked increase of leucocytes in 3 quarters and there was active phagocytosis of cocci. Attention was drawn to this milk by the fact that, like that of cow no. 1, the cream broke up when added to coffee. *Staphylococcus aureus* was isolated. Subcultures from 7 colonies were tested for fermentation. All but one fermented mannitol.

COW NO. 3.—This animal developed what appeared to be an ordinary case of mastitis shortly after freshening. In a couple of days the cow became very ill and died 4 days later. Fluid obtained from the udder was yellow and serous with masses of solid exudate. A heavy growth of *Staphylococcus aureus* in pure culture was obtained from it which fermented mannitol. About 4 weeks previously another cow had died with similar symptoms shortly after freshening. Material from this animal was not sent in for examination. No further cases have been reported.

COW NO. 4.—This cow had a calculus in one teat. When this was removed the

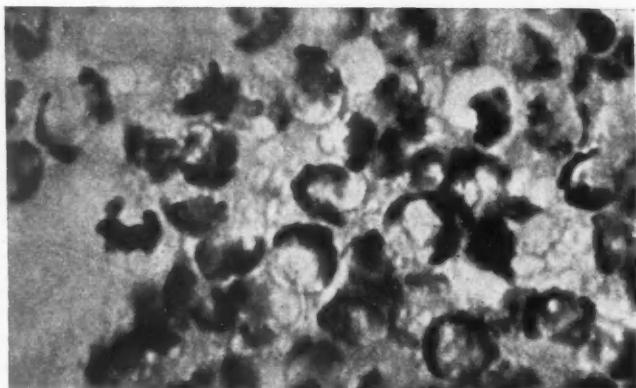


FIGURE I.

Ring-shaped effect in nuclei of swollen polymorphonuclear leucocytes in cow no. 1.

quarter was found to contain a yellow, serous fluid with grey, fibrinous masses of exudate, from which a pure culture of *Staphylococcus aureus* was obtained. The culture fermented mannitol.

Consideration of these cases shows that a staphylococcal infection does not, as a rule, produce severe symptoms. Two exceptions are the cow in herd 1 and cow no. 3. It is possible, of course, that at the onset of the disease there may be a general disturbance, but the history of these cases did not indicate it. Induration of the mammary gland occurs as in cases of streptococcal mastitis and was detected in 21 of these cases. This is particularly evident in herd 4, in which the entire absence of streptococci precludes the possibility of those organisms having produced the lesions. We have not encountered many cases of streptococcal mastitis that have cleared up, and certainly this would not occur in all these animals. Steck refers to recovery of 10 per cent of his cases. In the past few years we have had a number of cases of staphylococcal mastitis that terminated fatally but only one was encountered in this series.

We are satisfied that the 30 cases reported here were due to staphylococcal infection. Doubtful cases have been excluded as of undetermined cause, and it is possible that some of them should be added to the staphylococcus group. The percentage of this type of infection in the cattle examined by us (21 per cent) has been greatly increased by herds 4 and 8. If these cows were excluded the incidence of such infections in the other 6 herds would be only 3.3 per cent.

FERMENTATION REACTIONS AND LIQUEFACTION OF GELATIN

In preparing cultures of staphylococci, beef extract broth, pH 7.8, containing Andrade's indicator with 1 per cent of lactose, maltose, mannitol and glycerol, was used. The sugars were added in sterile solution. Stab cultures were made in beef infusion gelatin and incubated for 3 weeks at room temperature. In using the carbohydrate media incubation was conducted for 7 days at 37°C.

One hundred and thirty-one cultures were examined. All fermented lactose. Five did not ferment maltose. Four of these were mannitol negative. They were isolated from 2 normal, 1 suspicious, and 2 streptococcal cases. Forty-six strains fermented glycerol, 13 of these only slightly. They were from all types of infections and normal cows. Ninety-four fermented mannitol. Details of these are given in table II.

TABLE II
FERMENTATION OF MANNITOL BY *Staphylococcus Pyogenes*

Source	Mannitol+		Mannitol—	
	Orange	White	Orange	White
Staphylococcal mastitis	46	1	3*	1*
Streptococcal mastitis	18	12	7	1
Other infections	4		3	
Suspicious	6	2	4	1
Normal	5		12	5

*Mannitol+ strains were also isolated from the same cows.

Mannitol fermenting strains were obtained from only 5 cows with apparently normal udders (5.3 per cent) but were isolated from 81 or approximately 86 per cent of udders with staphylococcal or other infections.

Seventeen of the strains that failed to ferment mannitol were isolated from normal udders (approximately 46 per cent). Four were isolated from cases of staphylococcal mastitis, but mannitol fermenting strains were also isolated from these cows. Including these 4 strains, 15 or 40.5 per cent were isolated from infected udders.

Eight mannitol positive and 5 mannitol negative strains were isolated from suspicious cases. These animals were classified as suspicious on account of considerable activity in the cellular elements without definite clinical or chemical changes. Undoubtedly some would prove to be only temporary disturbances while others would become definite cases of mastitis.

Fleming (11) considers that the fermentation of mannitol may be used as a rough test to distinguish between the *Staphylococcus pyogenes* and the *Staphylococcus epidermidis*

groups. He also points out that there is some evidence that the chromogenic power is not constant and that *aureus* strains in certain conditions may lose this quality.

Plastridge *et al.* (7) state that preliminary observations indicate that the staphylococcus strains associated with mastitis ferment mannitol, whereas the apparently harmless strains studied have failed to ferment this alcohol.

Our results appear to support the view of Plastridge and his associates in that only 5 of 94 mannitol positive strains were isolated from apparently normal udders (5.3 per cent), while 46 per cent of the negative strains came from this source. The other negative strains were obtained from infected udders but there were, with the exception of the suspicious cases, other bacteria to account for the infections.

The white strains of staphylococcus all liquefied gelatin, were equally as haemolytic on blood agar as the orange strains, and did not appear to differ from them by any of our tests. Only one, in herd no. 8, was incriminated as the causative agent. We have had a number of *aureus* strains that were white at first, developing a distinct orange colour on subsequent subcultures. Also some *aureus* strains have been mannitol negative at first, later fermenting this alcohol. Only 4 *aureus* strains failed to liquefy gelatin. Three of these were from normal and one from a suspicious udder. All were haemolytic on rabbit blood agar plates.

TOXIN PRODUCTION

Eighty strains of staphylococci from normal and infected udders were examined for toxin production by the method employed by Dolman (12).

Semi-solid agar in Petri dishes was seeded with young broth cultures of staphylococci and placed in a vacuum jar. The air was displaced with oxygen. The jar was exhausted to one-third the height of the manometer column and replaced with carbon dioxide. The jar was then incubated at 37°C. for about 42 hours. The semi-solid medium was squeezed through cheesecloth, centrifuged, and filtered through paper and a Mandler candle. The first few cc. of filtrate were discarded. The filtrates were tested for sterility.

Dilutions of 1:100, 1:200, 1:400 and 1:600 were prepared and these and the undiluted filtrate were tested by mixing 1 cc. of each with 1 cc. of fresh, washed 1 per cent rabbit cells in salt solution. Tubes were incubated for 1 hour in the water bath at 37°C. Readings were made at 15 minute intervals. Longer observations were made in some cases and haemolysis occurred in a few instances after 1 hour, but as a rule the reaction occurred in 15 minutes. Those recorded here occurred within 1 hour.

Table III shows toxin production of strains and the relation of this to mannitol fermentation.

TABLE III
TOXIN PRODUCTION AS INDICATED BY HAEMOLYSIS

Degree of Haemolysis	Mannitol	Mannitol
	+	-
None	18	21
Undiluted partial	11	6
Undiluted complete	12	3
Undiluted complete, 1:100 partial	3	
1:100 complete, 1:200 partial	3	1
1:400 complete, 1:600 partial	2	

It will be seen in table III that 10 of the 31 mannitol negative strains (32.2

per cent) and 31 of the 49 mannitol positive strains (63.2 per cent) produced toxin, as indicated by the haemolytic activity of the filtrate. Or conversely, 67.8 per cent of the mannitol negative strains and 36.8 per cent of the mannitol positive strains did not produce toxin.

Relationship of Source of Strain to Toxin Production

The source of the 80 strains examined for toxin production is shown in table IV.

TABLE IV
SOURCE OF CULTURES TESTED FOR TOXIN PRODUCTION

Haemolysis	Mannitol	No. of Strains	Normal Udder	Staph. Mastitis	Strep. Mastitis	Suspicious
None	+	18	3	11	4	
	—	21	13	4	2	2
Undiluted partial	+	11	1	10		
	—	6	2	2	2	
Undiluted complete	+	12		10		
	—	3	1	1	1	
Undiluted complete and 1:100 partial	+	3		2		1
1:100 complete and 1:200 partial	—	1		1		
1:400 complete and 1:600 partial	+	2		2		
Totals:		80	20	46	12	2

In table IV it is seen that 31 of 46 strains from staphylococcal mastitis (67.4 per cent) and 4 of 20 strains from normal udders (20 per cent) produced toxin. The 12 strains from streptococcal udders were evenly divided as to toxin production.

Dolman (13) agrees with Stevens and Carp (14) in finding, in human cases, no close relationship between the clinical severity of a staphylococcal infection and the ability of the responsible microorganism to form toxin. Parish, O'Meara and Clark (15), also referring to human cases, report that in their series there was no relationship between the potency of the toxin and the clinical severity of the condition from which the strain was isolated.

Injection of Toxin in Guinea-pigs

Forty-four filtrates were injected into the hearts of guinea-pigs weighing about 350 grams. The dose was 0.2 cc. of undiluted filtrate. Three guinea-pigs died about 4 hours after injection. Two of the lethal filtrates were obtained from staphylococci isolated from the same cow, a chronic case of staphylococcal mastitis, about a month apart. These two showed complete haemolysis in 1:400 and partial in 1:600. The injections were repeated, with the same result. The third lethal filtrate was obtained from a white, mannitol negative staphylococcus obtained from the udder of a cow infected with *Streptococcus mastitidis*. This filtrate produced complete haemolysis in 1:100 and partial in 1:200. None of the other guinea-pigs showed any bad effects from the injections. The filtrate from the fatal case of mastitis produced complete haemolysis in 1:100 and partial haemolysis in 1:200. It was not harmful to the guinea-pig.

COMPARISON OF TWO STRAINS OF *Staphylococcus aureus* FROM CHRONIC STAPHYLOCOCCIC MASTITIS

These strains were isolated from the cow described as no. 1 earlier in this paper. On March 27th a pure culture of *Staphylococcus aureus* was obtained from all quarters. Colonies on blood agar from the left hind quarter were smaller and yellower than those from the other 3 quarters. All grew equally well on agar subcultures but the left hind quarter strain showed more colour than the others and was drier and more adherent (Fig. 2). Fermentation reactions were identical but the left hind strain was an active toxin producer. It produced complete haemolysis in 1:400 and a partial reaction in 1:600 and killed a guinea-pig by intracardiac injection. Filtrates of the other strains produced only partial haemolysis in 1:100 and were harmless to guinea-pigs.



FIGURE II.

Staphylococcus aureus isolated from cow no. 1. Twenty-four hour culture.
A. Small, highly coloured type from left hind quarter.
B. Larger, dull coloured type from other quarters.

On April 16th a pure culture was obtained from each quarter and again the colonies from the left hind quarter were smaller and brighter in colour. Fermentation was the same for all and toxin production was identical with the former examination *in vitro*. The left hind quarter culture filtrate again killed a guinea-pig.

A third examination was made on September 8th. The left hind quarter yielded the same pure culture of fine, bright coloured colonies, both on blood and plain agar. No growth was obtained from one of the front quarters but the other two still showed the dull coloured, creamy type of colony. Fermentation reactions were again the same. A filtrate of culture from the left hind quarter produced complete haemolysis in 1:100 while the other two only gave a partial reaction in that dilution.

Clinical examination in September showed both hind quarters to be

indurated. The left did not appear to be as bad as the right one, and milk from it was normal in appearance, whereas milk from the right hind quarter was watery, did not coagulate with rennet and was dark green by the bromthymol-blue test. Microscopically the right hind quarter showed mucinous material, while in the left hind quarter active phagocytosis of cocci was proceeding.

There did not appear to be any relationship between toxin producing ability and clinical findings in this case, but it is interesting that the small colony, a highly coloured strain, was isolated from the one quarter only at each examination. There was no admixture of the two types in the four quarters on any occasion. Many colonies were fished in order to check this.

FOOD POISONING STRAINS OF STAPHYLOCOCCI

Staphylococci are of public health interest on account of the outbreaks of staphylococcal food poisoning that have been reported. Dolman (12) estimates that at least 500 persons in the United States were affected acutely in 5 years.

Crabtree and Litterer (16) in 1934 report that 233 persons in an institution in Tennessee were attacked with acute gastro-intestinal condition, nausea, vomiting, weakness, and sometimes diarrhoea. A yellow haemolytic staphylococcus was isolated from the vomitus and from 2 cows in the institution herd which were affected with mastitis. Filtrates of the staphylococcus from both udders and vomitus produced similar symptoms when ingested by volunteers. The food poisoning substance is apparently different from the toxin. Dolman considers that it is produced by only a few strains and that it is a special metabolite, the formation of which is favoured by laboratory conditions which could seldom be attained in contaminated foodstuffs.

SUMMARY

In a series of 260 cattle, 143 were affected with mastitis. Ninety-four were infected with streptococci and 4 with other bacteria. In 15 the cause was not determined, while in 30 staphylococci were incriminated.

Twenty of the 30 cases of staphylococcal mastitis occurred in 2 herds, in which staphylococci were the only pathogenic organisms isolated. Swelling or induration was detected in 21 of these animals in one or more quarters. Fourteen of 18 cows in one herd were affected. The milk of all was abnormal by the bromthymol-blue or rennet test and the udders of 12 showed indurations. Therefore, in addition to its occurrence in sporadic cases, staphylococcal mastitis also occurs as a herd infection.

Two cases were severe and one of these had a fatal termination. The other animals showed no constitutional disturbance at time of examination.

One hundred and thirty-one cultures of staphylococci from udders were examined. All fermented lactose. Five failed to ferment maltose. Forty-six strains fermented glycerol. Ninety-four fermented mannitol. Only 5.3 per cent of the mannitol positive strains were isolated from apparently normal udders and 46 per cent of the mannitol negative strains came from this source.

Toxin was produced in semi-solid medium by 41 of 80 strains tested. Thirty-one were mannitol negative and 10 of these produced toxin (32.2 per cent). Forty-nine were mannitol positive and 31 of these produced toxin (63.2 per cent). Three of 44 filtrates proved fatal for guinea-pigs by intra-cardiac injection. No relationship was observed between toxin production and clinical severity.

Toxin was produced by 67.4 per cent of the strains recovered from cases of staphylococcal mastitis and from 20 per cent of the strains from normal udders.

A strain of *Staphylococcus aureus* producing a small highly coloured colony persisted in one quarter of an udder for 6 months. The other quarters yielded the commoner type of this organism. There was no admixture of strains. The small colony type was a stronger toxin producer than the others.

Attention is drawn to work which suggests the possible public health importance of staphylococcal mastitis.

ACKNOWLEDGMENTS

The writers are grateful to Dr. H. B. Speakman for his advice in connection with this work, also to Dr. C. E. Dolman; and to their colleagues Doctors A. L. MacNabb, D. V. Reed, R. G. Law, G. C. Lawrence, A. H. MacLeod, and S. Haslett, who have kindly supplied material and information.

REFERENCES

- (1) Munch-Peterson, E.: Survey of the Literature on Bovine Mastitis. Vol. 1. McMaster Animal Health Lab., Sydney, Australia, 1934.
- (2) Wall, Sven: Die Euterentzündungen der Kuh. F. Enke, Stuttgart, 1908. Cited by Minett et al. (5).
- (3) Savage, W. G.: 37th Ann. Rep. Local Govt. Board, England, 1907-08. Cited by Jones (4).
- (4) Jones, F. S.: J. Exper. Med., 1918, **28**: 721.
- (5) Minett, F. C., Stableforth, A. W., and Edwards, S. J.: J. Comp. Path. & Therap., 1929, **42**: 213.
- (6) Rosell, J. M.: La Mammite Streptococcique de la Vache. Ministère de l'Agriculture de la Province de Québec, 1933.
- (7) Plastridge, W. N., Anderson, E. O., Brigham, G. D., and Spaulding, E. H.: Storrs Agr. Exper. Stat. Bull. 195, March, 1934.
- (8) Steck, W.: Cornell Vet., 1935, **25**: 6.
- (9) Hadley, F. B.: J. Dairy Sci., in press.
- (10) Steck, W.: Cornell Vet., 1935, **25**: 1.
- (11) Fleming, A.: A System of Bacteriology in Relation to Medicine. Med. Res. Council, H.M.S.O., London, 1929, p. 24.
- (12) Dolman, C. E.: J. Infect. Dis., 1934, **55**: 172.
- (13) Dolman, C. E.: Canad. Pub. Health J., 1932, **23**: 126.
- (14) Stevens, F. A., and Carp, L.: Proc. Soc. Exper. Biol. & Med., 1927, **24**: 592.
- (15) Parish, H. J., O'Meara, R. A. Q., and Clark, W. H. M.: Lancet, 1934, May 19, p. 1054.
- (16) Crabtree, J. A., and Litterer, W.: Am. J. Pub. Health, 1934, **24**: 1116.

EDITORIAL SECTION

EDITORIAL BOARD

R. D. DEFRIES, M.D., D.P.H., *Chairman*

J. T. PHAIR, M.B., D.P.H., and N. E. MCKINNON, M.B., *Associate Chairmen*

R. L. RANDALL, *Editorial Assistant*

G. D. PORTER, M.B., *Public Health Administration.*

A. L. MCKAY, B.A., M.B., D.P.H., *Epidemiology and Vital Statistics.*

A. L. MACNAB, B.V.Sc., *Laboratory.*

GORDON BATES, M.B., *Social Hygiene.*

E. W. McHENRY, M.A., F.R.D., *Food, Drugs and Nutrition.*

MARY POWER, B.A., *Public Health Education.*

A. H. SELLERS, B.A., M.D., D.P.H., *Books and Reports.*

D. T. FRASER, B.A., M.B., D.P.H., *Mental Hygiene.*

A. E. BERRY, M.A.Sc., C.E., Ph.D., *Public Health Engineering.*

LAURA A. GAMBLE, REG.N., *Public Health Nursing.*

J. G. CUNNINGHAM, B.A., M.B., D.P.H., *Industrial Hygiene.*

JAMES CRAIGIE, M.B., Ch.B., F.R.D., D.P.H. ST. AND., *Current Health Literature.*

THE TWENTY-FIFTH ANNUAL MEETING

THE health conference in Vancouver, which was international in scope, was brought into being as the result of fortunate circumstances and the careful planning of those who are officially responsible for public health leadership in British Columbia. Five associations, the State and Provincial Health Authorities of North America, the Canadian Tuberculosis Association, the Western Branch of the American Public Health Association, the Canadian Public Health Association, and the British Columbia Public Health Association, joined in a week of meetings from June 22nd until June 27th. The program provided ample opportunity for each of the associations to meet separately. Joint sessions of the Western Branch of the American Public Health Association and the Canadian Public Health Association were features of the meeting, being held on Wednesday, Thursday, and Friday afternoons. The registration was approximately five hundred and the outstanding success of the meeting was due in no small part to the enthusiastic support of the members of the Western Branch of the American Public Health Association.

The program committee is to be heartily congratulated. Not only were the general sessions of special interest and the topics well presented but the Section meetings made a general appeal to health officers. Regret was expressed by many at their inability to attend several Section programs which were held at the same time. Accommodation for the Laboratory Section meeting was taxed to capacity and the program was greatly appreciated. The meetings of the Sections of Public Health Education, Public Health Nursing, and Vital Statistics and Epidemiology were also well attended. Publication of many of these papers will be made in the JOURNAL during the coming months. The social interludes were typical of Pacific Coast hospitality; even those responsible for the weather seemed conscious of their responsibility.

No matter how casual the contact, one could not help but be impressed with the attitude of those locally responsible for the public health program of those states and provinces bordering on the Pacific Coast. It can best be described as a blending of youthful enthusiasm with sound experimentation.

They are attempting to create on the part of the public whose advisers they are a concern comparable to their own in the solution of the pressing health problems. The vaunted leadership of the East in health direction and hygienic control is fast being challenged by our confreres in the West of Canada and the United States of America.

On this occasion, the first on which members of the American Public Health Association and the State and Provincial Health Authorities of North America have joined in arranging a program with the Canadian Public Health Association, the unity of interest in public health throughout the continent was continuously manifested and much good should result from the joint discussions of topics of mutual interest. An excellent illustration of the value of such discussions was contained in a resolution passed by the Canadian Public Health Association urging that attention be given by the federal and provincial authorities to the menace of sylvatic plague, on which attention is being focused in the Pacific and Western states and to the very borders of Alberta and British Columbia.

The Vancouver meeting will long be remembered as one of the most profitable and enjoyable meetings that the Association has convened.

THE MENACE OF VIRULENT SMALLPOX

EPIDEMICS of virulent smallpox in Canada have not been frequent. Nevertheless, those epidemics which have occurred have been of such dramatic character that the maintenance of all possible precautions and watchfulness is substantially warranted. Figures from some of these outbreaks serve to emphasize what has happened in the past and what may happen in the future. In the Montreal epidemic of 1885 over 3,000 deaths occurred in a very short period. More recently, in Windsor, in 1924, there were 67 cases with 32 deaths and in Vancouver in 1933, 56 cases and 17 deaths.

If vaccination and revaccination were rigorously and universally practised, such situations as these could not arise. The credit for the fact that the epidemics which have occurred were brought promptly under control must be given to those public health officials who dealt with these emergencies. Their efficiency in instituting isolation and quarantine, in tracing sources and contacts, and in securing the confidence and co-operation of the public so that wholesale vaccination could be carried out, should be a matter of extreme gratification.

An admirable account of a small outbreak of smallpox which occurred in the late fall and early winter of 1935-1936 in Vancouver appears in this issue. The disease was imported from Asia and was of the extremely severe type. That this outbreak was of such minor proportions was due, as the authors point out, to two circumstances. First was the fortunate delay of a ship by fog so that a member of the crew who was coming down with the disease was ill when port was reached and immediately hospitalized, contacts being consequently minimized. Secondly, control measures were adequately applied and the possibility of spread removed. It is idle to conjecture concerning the number of cases which might have occurred but it must be recognized from this outbreak that

we are still vulnerable to the ravages of the disease in this country. Chance will not always be in our favour as it was in this instance.

Establishment of an early diagnosis is an important essential in the adequate control of smallpox. Clinically this may not be an easy task for the disease may present confusing features due to unusual haemorrhagic characteristics or to modification by previous vaccination, in which case it may readily be mistaken for varicella. The development, therefore, of an efficient laboratory test as an aid in the diagnosis of smallpox has been a signal contribution in this field. In another paper in this issue the technique and the application of the test are described. It is based on the fixation of complement by extracts of smallpox crusts or vesicle or pustule fluid and antivaccinia serum. The test is specific and sensitive and may be applied early in the course of the disease. Its possibilities were well illustrated in this recent Vancouver outbreak. In case 3 the balance of clinical and epidemiological evidence appeared to favour varicella. However, on submitting samples of crusts and pustule fluid from this case to the complement-fixation test a positive result occurred and the diagnosis was changed to variola. The result of the test was confirmed in no uncertain fashion when a contact of this case developed fatal smallpox. Where difficulties of diagnosis are encountered, physicians should avail themselves of this test.

It is extremely fortunate that a specific preventive measure, well proved over a long period of years, exists for this highly contagious disease. Unfortunately, however, a false sense of security is responsible for the present neglect to protect the public by general vaccination. No one can appreciate to the full the tragedy of smallpox on the one hand and the value of vaccination on the other except those who have worked in the midst of an epidemic of this disease. In such instances we should be virtually helpless without vaccination. In the Vancouver epidemic of 1933 there was not one case of smallpox in a person who had been vaccinated within 15 years. But there were 17 deaths, *16 of which were persons who had never been vaccinated*. One had been vaccinated 36 years previously. In the Windsor epidemic of 1924, 71 per cent of cases never vaccinated died, while of those who had been vaccinated at any time in their lives *none* died. In this epidemic no person who had been vaccinated within 12 years took the disease at all. Such records speak for themselves and they could be multiplied indefinitely. The truly remarkable protection afforded by vaccination is established, not only by the resistance to or survival from the disease of vaccinated persons as compared with the morbidity and mortality among the unvaccinated, but also by the promptness with which epidemics are stamped out when general vaccination is carried out.

With such lessons as we have had in this country in the past it should not be necessary for deaths to occur before we are stimulated to action. Our danger is real. We have the sea-ports open to both East and West and a tremendous southern frontier. This last outbreak of smallpox in Vancouver provides another example of what can happen. Every effort should be made by physicians and public health authorities to bring the facts before the public and to urge vaccination and revaccination as required. To fail to do so is to neglect a professional and moral responsibility.

F.O.W.

REPORTS FROM THE ANNUAL MEETING*

Part III

THIRD ANNUAL REPORT OF THE COMMITTEE ON THE CERTIFICATION OF CAUSES OF DEATH†

THE first annual report of this Committee was devoted to a summary of its investigations and recommendations on the form of the certificate of registration of death. This report was adopted by the Vital Statistics Section meeting in Montreal in June, 1934. Following a conference of the Dominion Bureau of Statistics with representatives of the provincial registrars and medical officers of health, the recommended form of the certificate was accepted by all provinces with minor changes and a resolution endorsing the recommendations of this Committee as amended was passed at the final general session of the convention.

During the second year of its activity, the field of the Committee's work was considerably broadened and certain new problems for consideration were defined and discussed. These were embodied in the Committee's second annual report presented at the annual meeting in Toronto, 1935. In this report the steps leading to the introduction of the revised Canadian medical certificate of death were described and the part played by this Committee indicated. At this time it became apparent to the members that education of medical students and medical practitioners in the principles of death certification was essential to the achievement of mortality statistics which would be a more accurate expression of the opinions of medical practitioners. At the invitation of the Dominion Bureau of Statistics through Mr. W. R. Tracey, the Committee undertook to draft the text of a revised reference manual for physicians on death registration, the details of which were presented in the second annual report. Preliminary discussion of the problem of revision of the International List of Causes of Death was begun and further deliberations upon the subject of confidential certification were entertained. Lastly, the Committee considered some of the major aspects of the question of "stillbirth" registration and certification, including the nature of a suitable working nomenclature for the classification of causes of "stillbirths".

The Committee's third session involved further effort upon problems which were defined in its second annual report. The various phases of this work are presented in sections, as follows:

*Presented at the Twenty-fifth Annual Meeting of the Canadian Public Health Association, Vancouver, B.C., June, 1936.

†This Committee's Report and Recommendations concerning the Revision of the International List of Causes of Death will be published in the September issue.

SECTION I: THE NEW REFERENCE HANDBOOK IN DEATH CERTIFICATION

During the current session the final draft of the proposed revised handbook on death registration was formally approved by the Dominion Bureau of Statistics, and the Committee was given the opportunity of offering further suggestions when the material was set in type. The Bureau has indicated that this new handbook will shortly be available for distribution. Its purposes are broadly two: (1) as a source of information for certifying physicians in Canada; and (2) as an aid in teaching the fundamentals of vital statistics to medical students. The Committee again extends its appreciation to Dr. Coats, Dominion Statistician, for making this revision possible.

SECTION II : PLANS TO ADVANCE THE TEACHING OF VITAL STATISTICS

Last session, pursuant to a resolution passed at the annual meeting in Montreal, 1934*, two articles on the death certificate were prepared for the Committee and published in various Canadian journals. The publication of the new handbook on death registration will be a further step toward medical education in the proper use of the death certificate.

The Committee has followed up the tentative recommendation which it made, namely, that "practical teaching in the use of the medical certificate constituted an important step toward securing the co-operation of physicians in obtaining satisfactory medical returns." A suitable exercise involving instruction and practical work in the principles and practice of death certification has been drafted for the Committee. Practical trial has already been made of this exercise with a group of 150 medical students. The plan adopted was to provide each student with a mimeographed booklet containing the essential details regarding the practice of death certification and questions based thereon. Such an exercise can easily be handed in by the student, marked, and returned to him. In this way the Committee feels that the important practical points will be impressed upon the student's mind.

The Committee will report further on this experiment and it is hoped that through the co-operation of the medical faculties of Canadian medical schools, such an exercise may be incorporated in the curriculum of each. The Committee plans to make copies of this exercise available to those medical schools which request them and feels that it is extremely desirable that instruction be given to medical students both in "the social and scientific value of official statistics of causes of death as well as in the practical construction and use of the medical certificate".

SECTION III: THE REGISTRATION AND CERTIFICATION OF STILLBIRTHS

The interest of this Section in the stillbirth problem began with the work

**"That this Association, realizing that it is of very great importance that medical students and medical practitioners be given special instructions in the principles governing death certification and the value of accurate statements on the medical certificate of death, request the co-operation of the Faculties of Medicine of our universities and the Canadian and Provincial Medical Associations."

of the Committee on the Definition of Stillbirth for Statistical Purposes. The definition proposed by this Committee was formally adopted in 1931 at Regina and was actually that elaborated by a Special Committee of the Health Section of the League of Nations in 1925 (birth of a foetus after 28 weeks or 6½ months of pregnancy, measuring at least 35 cms. from the crown to the heel, in which pulmonary respiration does not occur). It is important to note in passing that this definition does not agree with the official definition employed either in the United States or in England and Wales where the criterion is not pulmonary respiration but "any sign of life". Holland and others, however, have emphasized the fact that the only criterion of independent existence is the establishment of pulmonary respiration—this function definitely distinguishing foetus from infant.

Many workers have expressed the opinion that ultimately the term "stillbirth" should be deleted from statistical nomenclature and the term "foetal death" substituted, with a distinction of the latter as (a) ante, (b) intra, and (c) post natal foetal deaths. The Committee has given careful consideration to these points and notes that, although the term "stillbirth" is widely used, it is not used in a uniform sense and therefore further clarification of this situation is desirable. Foetal death is a much more specific term and is one which lends itself better to specific definition. It can be sub-divided into (a) viable foetal deaths (our present "stillbirths") and (b) non-viable foetal deaths.

The Committee gave further thought to the desirability of introducing a separate standard Canadian form for "stillbirth" registration, such, for example, as would provide for a statement of medical opinion on the cause of death. In the province of Quebec, provision has been made since 1932 for a special "statistical return for an embryo, a stillborn child, or an infant having lived less than 24 hours" (Form C). Great success has been achieved in the use of this special form and the data collected thereby substantially justify its use. This Committee is firmly of the opinion that the introduction of a standard form for the registration of "stillbirths" in Canada, which would dispense with the present double registration system, is desirable. Furthermore, it is suggested that, before such a form is introduced for general use, the new statistical definition of stillbirth be incorporated into the registration acts of the various provinces.

The Committee therefore notes with interest that in March last the registrar-general of each of the provinces was approached with the object of securing opinions on the practicability of introducing a single stillbirth registration form to replace the present double registration system. In view of this it is desirable that the Committee immediately consider such questions as the nature and extent of supplementary data which it is desirable to include on such a form, so as to be in a position to assist the Bureau. The following are some of the points which the Committee feels should be considered for inclusion on a special "stillbirth" form:

- (a) Period of gestation at birth;

- (b) Labour-induced, spontaneous, instrumental, or operative;
- (c) Time of foetal death in relation to labour: (i) before, (ii) during, (iii) after, labour;
- (d) Condition of foetus at birth—fresh or macerated;
- (e) Occurrence of spontaneous respiration.
- (f) Autopsy and findings.

The additional information to be required on such a form must be of particular practical interest and value and be such as not to put too great a burden upon the medical profession.

Foetal mortality, particularly that among foetuses reaching the age of viability, described as stillborn, is of great importance because many of the causative factors involved are closely related to those which are responsible for neonatal deaths. This fact lends weight to the Committee's efforts in this field, and in this connection an extensive study as to the nature of a workable scheme for the classification of causes of stillbirth is essential in view of the possibility of the introduction of a special form for the registration of viable foetal deaths. Many classifications have been devised but few are very satisfactory. The Committee believes that such a classification need not be bound by the nature of the present rubrics in the International List but could be so devised as to fit clinical and pathological requirements. The sub-committee on stillbirths of the Committee on Accuracy of Certified Causes of Death of the American Public Health Association has offered a suggested standard stillbirth certificate and nosology, and the latter reflects the opinion of this group that the approved list of terms in such a nomenclature should be comparable as far as practicable with the International List of Causes of Death. With certain reservations this may be desirable, but this Committee is not in full agreement with this opinion.

In view of the extensive work to be done on this phase of the Committee's work, it is recommended that Dr. E. Gagnon, Dr. Paul Parrot, Mr. W. R. Tracey, Dr. H. A. Ansley, and Dr. A. H. Sellers, with power to add to their number, be appointed as a special sub-committee to undertake such special work and collection of data as has been indicated to be immediately desirable.

SECTION IV: CONFIDENTIAL DEATH CERTIFICATE

Improvement in validity and comparability of recorded mortality statistics depends on such factors as clarification of the procedure of certification, revision of the International List of Causes of Death, medical education and the development among physicians of a realization of what such medical statistics are and what value they can be, if reliable, to the profession itself.

The present method of registration and certification which may in general be referred to as an "open" method as opposed to the "closed" or confidential type has frequently been called into question by physicians themselves and for this reason the problem deserves careful thought. In this connection the Committee draws attention again to the fact that the scheme for medical certification in England and Wales is virtually confidential in character, the

practitioner being required (since 1927) to deliver the medical certificate direct to the registrar. Official franked envelopes are provided for this purpose. Furthermore, this is in general the situation in the province of Alberta wherein the physician's notice of death (form G) may be said to do duty as a confidential certificate of cause of death since it is transmitted direct to the division registrar. The Committee has also been following closely the experiment in confidential certification in Westchester County Health District, New York.

Confidential certification is extremely desirable from many points of view. The present system in Canada is open to many objections and a "closed" scheme such as that in England and Wales would strengthen the co-operative relationship between the physician and the statistical office. It is desirable to secure data as to the specific effect of such procedure in Canada. The Committee therefore recommends that an experiment be initiated in Canada to determine the nature and extent of the advantages in fact of confidential death certification and that a special sub-committee on Confidential Death Certification be appointed under the chairmanship of Dr. Paul Parrot (with power to add) to consider and investigate this problem.

SECTION V: RECENT EXPERIENCE WITH THE NEW CANADIAN DEATH CERTIFICATE

The Committee felt that it was opportune and valuable to determine the measure of success of the new death certificate in achieving its objective, viz., to make Canadian mortality statistics a more accurate expression of the opinions of the medical practitioner respecting causes of death. This appraisal was made in two ways, namely, by (a) a questionnaire regarding the medical certificate submitted to the chief executive officers in charge of vital statistics in the provinces; (b) analysis of the statements of cause of death in a sample of death certificates.

Review of Questionnaires

The Committee received detailed reports from seven provinces. The general consensus expressed in the replies received was that the new death certificate was a decided improvement over the old one and that the former confusion of "cause of death" and "contributory cause" is being replaced by a clear statement of the opinion of the certifying medical practitioner. It was also pointed out that the younger physicians use the new form well, while older practitioners accustomed to the old certificate in many instances disregard the request for a logical sequence when multiple causes are stated. In several instances it was stated that decidedly fewer supplementary inquiries were being found necessary. These findings are in keeping with the expectation of the Committee.

In regard to the desirability of adding "duration" to the form, the opinions were divided but with the ultimate purpose of the form clearly in view and an appreciation of the limitations of statements of duration, when given, the Committee felt that the weight of evidence was decidedly opposed. The Committee's studies and the opinions of its members are in general agreement

with this stand. (See "Consideration of the Desirability of Adding Duration (or Date of Onset) to the Present Medical Certificate", page 412.)

The common errors committed by practitioners in certification, which are specifically related to the use of the new form, may be summed up as follows:

- (a) Disregard of the meaning of "due to" and of the request for morbid conditions in a causally related sequence where multiple causes are stated under section I of the form, i.e., mixing causally related and unrelated morbid states under I;
- (b) Complete reversal of order of statement under I;
- (c) Double entries—two causes on a line;
- (d) Multiple causes stated in obviously improper order under I;
- (e) Unnecessary detail in statement, viz., terminal causes, etc.
- (f) Inadequate data in deaths from violence or accident (section 27).

The errors which are now being made are those anticipated by the Committee in its extensive investigation and trials two years ago and they indicate *not* a defect in the form but a failure of certifying medical practitioners to clearly understand what is desired. Similar difficulties were met with in the first few years' experience in England (1927-), but the volume of these has rapidly diminished. In the opinion of this Committee, however, the attention of practitioners should immediately be drawn in an appropriate way to these and other common errors.

Analysis of Medical Statements in a Sample of New Death Certificates

In order to determine the manner in which the new certificate was being used by physicians and to supplement the information received from the provinces, a study was made of a sample of death certificates from Toronto experience.

The sample comprised 935 deaths from all causes certified on new death certificates in Toronto covering the period May to August, 1935. From this sample 37 stillbirths were excluded, leaving 898 for analysis. These certificates were studied to ascertain (a) the type of practice in certification which obtained, and (b) the proportion in which a statement of duration would be of value.

Medical statements of cause of death on the new certificate were divided into four groups as follows:

1. Single entry—one cause only;
2. Multiple causes stated in a clear and reasonable order;
3. "Inverted" entry—multiple causes entered without regard to the requirement of the form and therefore obscuring the physician's viewpoint;
4. Double entry—two causes or more stated on one line and therefore ambiguous.

A summary of the findings on this basis is given in table I. Data from a recent English sample are included for comparison.

TABLE I
ANALYSIS OF CURRENT USE OF THE NEW MEDICAL CERTIFICATE IN ENGLAND AND WALES,
AND IN TORONTO

	England and Wales*		Toronto†	
	No.	%	No.	%
(1) Single entry.....	5637	57.0	110	12.2
(2) Multiple entry in reasonable order and without ambiguity.....	4001	40.5	548	61.1
(3) Inverted entry.....	107	1.1	240	26.7
(4) Double entry.....	147	1.5		
Total.....	9892	100.0	898‡	100.0

*Sample taken March, 1935, after eight years' experience with the new certificate (after Stocks).

†Sample taken May-August, 1935, six months after introduction of the new form.

‡Stillbirths excluded.

It is evident from this table that certifying physicians have disregarded the request to limit their statements to a single cause in all cases where this could be regarded as adequate since in only 12.2 per cent of cases were there single entries, against 57.0 per cent in the English sample. Of those certificates on which multiple causes were stated (87.8 per cent) about 70 per cent were of a satisfactory character (94 per cent in the English sample) while the remainder, constituting 26.7 per cent of the whole group, fell into the class of "double" or "inverted" entries, a proportion almost ten times that which was found by Stocks in England. It must be remembered in making this comparison that the English experience refers to a period eight years after the new form was introduced, during which time very considerable improvement has taken place. The above findings do, however, indicate a real need for education along certain definite lines.

Table II yields further information concerning the types of unsatisfactory entries (groups (1) and (2) of table I), and seems to emphasize the facts reported in the questionnaires returned to the Committee from provincial departments.

TABLE II
ANALYSIS OF UNSATISFACTORY ENTRIES IN TORONTO SAMPLE

Type of Entry	Number
Incorrect order under I.....	54
Misplaced causes under I.....	69
Misplaced causes under II.....	48
Reversal of Order under I.....	45
Double entry (two causes in one space).....	24
Total.....	240

These unsatisfactory statements are in large measure due to lack of familiarity of physicians with the use of the new death certificate. In view of this it is to be expected that the proportion of instances in which such returns are made will decrease. It is of interest to note that in all but about 50 of these 240 "unsatisfactory" entries (5.6 per cent of the total), the deaths could have been fairly readily assigned under present practice by careful consideration of each form. Further, in 12 instances only could it be said that the addition of a request for duration or date of onset to the form would have been any help, and in most of these the form had been incorrectly used. The unfortunate thing is, however, that although most of these 240 certificates could be coded readily with a reasonable chance of being "right", the physician's viewpoint—the thing which in the last analysis is desired—is not with certainty available.

One further point was brought out by this study, namely, that there was evidence that it would be desirable to provide some routine arrangement by which the physician could indicate that further information might subsequently be available (after autopsy or coroner's investigation) on request, either as the cause of death or supplementary questions which would enable more precise statistical classification. This arrangement is effective in England and Wales, and would seem to be worth consideration.

RESUME

The new Canadian medical certificate of death in so far as the statement of cause of death is concerned is essentially that which was introduced in England and Wales in July, 1927. For this reason the Committee has kept in touch with the British register office in order to learn the nature of English experience.

It is well to call attention to the official report upon the first six months' use of the new form in England. Herein it was stated that "both the request to state only one cause if this could be regarded as adequate, and inversion of the former order of statement, have been disregarded in many instances, with the result that the objects of the new form of medical certificate have so far failed to materialize." This report further stated that for the present, arbitrary rules of selection must still be retained despite the fact that the allocation of deaths on this basis must frequently involve a classification with which the physician would not agree. Subsequently it was found that "time was contributing to a more effective operation of the new certificate and that there was no ground for grave disappointment." Furthermore, the early difficulties which were encountered in England have rapidly decreased in volume so that at the present time the proportion of medical certificates in which the opinion of the certifying physician is obscured by statement of causes in the wrong order, has fallen to about 1 per cent.

Difficulties such as are now being noted by statistical offices in Canada in respect to medical statements of cause of death are inevitable. It will take an appreciable time for the medical profession to become accustomed to the new

method of certifying and during this transition period many will continue to use the certificate as if it were the old form.

It will be recalled that the original plan in England was that the new form would permit tabulations to be made entirely in the light of the certifier's viewpoint. That the new certificate there is now to achieve its original purpose is indicated by the fact that it has been "proposed to adopt the certifier's preference as indicated on the medical certificate in place of selection by rule beginning in 1941." It may therefore be said that the English medical certificate has achieved almost complete success within a period of fifteen years.

It is therefore important that Canadian experience with the new medical certificate, now and during the next few years, be viewed in the light of the above findings. The Committee believes that too much should not be expected at once and that if measures for the education of medical students and practising physicians in the principles and practice of death certification are pushed forward (for which there is an obvious need), there will undoubtedly be substantial improvement in certification in the next few years. In ten years' time we shall be in a better position to judge the true value of the new medical certificate.

Consideration of the Desirability of Adding Duration (or Date of Onset) to the Present Medical Certificate

In death certificates bearing a statement of multiple causes, duration has been considered to be of particular value. This situation has arisen largely because the death certificate formerly in use in Canada (also in England and Wales, and in the United States) did not give the physician the opportunity of clearly expressing his opinion as to the cause of death of his patient, and in cases where multiple causes are stated there has grown up a system of arbitrary rules, on the basis of which an equally arbitrary selection is made. For example in English and Canadian practice at the moment, in respect of statements of multiple causes (local diseases) the rule followed is: "Where two or more local diseases are certified together, that of longest duration should be preferred. If duration is not recorded (or cannot be inferred), any disease of a chronic nature should be preferred to a disease not so characterized; if neither disease can be assumed to be chronic, the first mentioned on the certificate (that mentioned under I, should be preferred to that under II, with our new form) should be selected."

As is well known, this rule has only limited application because many exceptions to it are defined in practice. Also in respect to general diseases, where two or more of these are jointly stated, within each group the disease of longest duration or that first mentioned on the form (that in I over that in II now) is as a rule chosen. It has been urged that the difficulty in arriving at a decision for classification when such multiple causes are stated would be practically eliminated if the provision were made for the statement of the duration of each item entered on the certificate. However, it has been shown conclusively by experience with the old certificate which provided for a statement of duration, that "duration" was frequently omitted; if not entirely, yet for one or more of a group of multiple causes stated. Furthermore, it has also been shown that usually what the physician gives is not duration but the period during which he has attended the patient, i.e., the length of time he has been aware of the disease in the patient, because he is often not in a position to state the true duration of the disease causing death. It has been also frequently noted that "when durations were stated on the old certificate, for two or more co-existing diseases, the actual nature of the morbid states themselves suggested that one of the durations must be incorrect. Then, too, the relative durations of two or more morbid states may have a different significance depending on the age of the patient." Furthermore, a request for duration constitutes an added burden on the certifying physician.

Many of the cases in which it is necessary to fall back upon duration are those in which the physicians have been very lax in certification, have no clear conception of the principles of death certification, and have stated multiple causes on the certificate "in an unreasonable or impossible order." In such instances, it would be obviously unwise to place the burden of the decision entirely upon a statement of duration which is seldom reliable, and particularly in just these cases it is extremely likely that it would not be given.

The Committee calls attention again to certain statements made by Mr. E. S. Macphail at the Annual Meeting in Saint John, 1933: "The fact that duration is not given (in many of the especially troublesome cases) for any of the causes where many are stated and that it is often omitted where only one or two causes are stated on the certificate, indicates that the adoption of a more elaborate certificate will by no means ensure that the physician will always be attentive to this matter. It may therefore be concluded that the mere provision of a place for 'duration' or 'date of onset' of each cause will not effectively accomplish the same purpose as separate questions which distinguish the immediate cause of death from its antecedent causes." In this connection, it will be recalled that the new medical certificate of death which has been in use in England and Wales since 1927 does not provide for a statement of duration. Instead, as now in Canada* reliance is placed upon the logical order of statement of causes for which provision is made, and there can be no doubt that the proportion of instances in which duration might, if given and supposed to be correctly stated, actually be a help in classification, has been greatly reduced by this provision for a logical arrangement of causes on the new medical certificate.

The studies made by this Committee have also made it clear that the value of the logical arrangement of causes (if multiple causes are stated) on the new certificate is particularly well recognized by those in charge of vital statistics who have medical training. The interpretation of medical statements on the new form is much easier for this group than for those without a medical background for the simple reason that the new form, properly filled out, clearly indicates the opinion of the certifying physician. There is no good reason why, for example, pulmonary tuberculosis should always take precedence over diabetes mellitus when the two diseases are both mentioned on the same death certificate. Arbitrary rules such as this are only a makeshift pending improvement in the certifying practice of the medical profession. That this improvement will be hastened by the new certificate has been conclusively demonstrated by English experience.

In correspondence with the British Register Office (March, 1936), Dr. Percy Stocks pointed out that in reference to the duration of diseases in deaths from joint causes: "It is our experience that the rules of preference do not always suffice to make a classification until an inquiry has been made as to the duration of one or other of the stated causes. In the case of two or more local diseases where duration is not recorded or cannot be inferred, preference is given to a disease of a chronic nature over one not so characterized. If neither disease can be assumed to be chronic, the one entered in space I is preferred to that in space II." But "cases of ambiguity on the grounds of duration which cannot be settled by selective rules are of sufficiently infrequent occurrence to make it possible to ask for further information, and it was not considered advisable on several grounds to introduce a request for duration on the new certificate."

It has been pointed out above that out of a sample of 935 death certificates from the City of Toronto in only about a dozen instances could a statement of duration have been any help and in only six would it have been a valuable and certain aid in classification (0.7 per cent). Therefore, the Committee feels, as does the British office, that cases of ambiguity on the grounds of duration, which cannot be settled by selective rules, are of sufficiently infrequent occurrence to make it possible to ask the physician for further data where needed.

SUMMARY

The Committee believes after careful consideration of available data at this time that the new death certificate introduced for use in January, 1935,

*Except Saskatchewan.

has been received with general satisfaction, and promises to be a substantial improvement on several counts over the certificate previously used. Furthermore, the information from the British Register Office leads the Committee to believe that the difficulties which are at present being encountered will steadily diminish in volume as physicians become more familiar with its use. For these several reasons the Committee is strongly of the opinion that the new certificate will ultimately prove to be an important factor in improving the accuracy of mortality statistics and urges that no further changes or additions to the medical section of the form be made, at least until several years of trial have been made. In particular the Committee believes that it is extremely desirable that duration or date of onset of stated causes of death continue to be omitted from the certificate.

In view of the fact that the British Register Office, after a period of eight years' experience with the new medical certificate, has indicated its intention, beginning in 1941, of changing the basis of classification to a literal reading of the order of the statements of causes on the certificate, so that the certifier's preference as stated will be accepted, the Committee further believes that it will be of practical value to investigate the feasibility of ultimately dispensing with arbitrary rules of selection at some future time in Canada.

In connection with the work of this Committee, the members desire to express hearty appreciation of the work of Dr. Sellers as Secretary during the past three years.

R. D. DEFRIES, *Chairman*; H. E. YOUNG, E. S. MACPHAIL, M. R. BOW, WM. WARWICK, PAUL PARROT, S. J. MANCHESTER, T. E. ASHTON, E. GAGNON, AND A. H. SELLERS, *Secretary*.

RESOLUTIONS

Following the presentation of this report and extended discussion by the members attending the conference called by the Section on May 4 and 5, 1936, the following resolutions were unanimously adopted:

RESOLUTION No. 1

WHEREAS, in the opinion of the special conference called by the Section of Vital Statistics and Epidemiology of the Canadian Public Health Association in Toronto on May 4 and 5, 1936, the new death certificate introduced for use in January, 1935, has been received with general satisfaction, from the reports received from the various Provincial Registrars and Departments of Health throughout Canada, and promises to be a definite improvement over the certificate previously used;

AND WHEREAS, in letters received from the Registrar-General of Great Britain relating to the experience over the past eight years with the use of a similar form of medical statement, it appears that the difficulties early encountered in its use by the medical profession have been steadily reduced until now in only about one per cent of certificates is the certifying physician's opinion obscured by incorrect order of statement, proving the value of the present form of statement;

AND WHEREAS the experience in Canada relates only to less than one year in a number of provinces,

Be it resolved that this conference record its belief that the new certificate will be an important factor in improving the accuracy of mortality statistics and that the minor difficulties

which have been reported in connection with its use will become less frequent as physicians become increasingly familiar with the new form.

Be it resolved further that no changes be made in the certificate as relating to the cause of death until a reasonable period of trial of several years be made and that in the opinion of this conference the inclusion on the certificate of the request for the period of duration for the cause or causes of death stated on the certificate should not be considered until the further experience referred to has been obtained.

RESOLUTION No. 2

WHEREAS, in the opinion of this conference, the use of the new death certificate will not accomplish its purpose of making more complete and accurate mortality statistics in Canada without the hearty and intelligent co-operation of the medical profession,

AND WHEREAS there are a number of common errors in certification, the correction of which would clarify the physician's viewpoint and simplify the task of those entrusted with the tabulation of mortality statistics,

AND WHEREAS the Dominion Bureau of Statistics has revised and enlarged the Pocket Reference for physicians as relating to the International List of Causes of Death under the title "A Manual on Death Certification",

AND WHEREAS this manual on death certification for physicians will be of great value both as a source of information for certifying medical practitioners in Canada and as an aid in teaching the fundamental principles and practices in death certification to medical students,

Be it resolved that this conference express its hearty approval of this action to the Dominion Bureau, believing that the publication of this manual in its new form and the making of copies available to physicians and to medical students in their graduating year will be a highly significant contribution to this objective.

Be it resolved further that the Section of Vital Statistics and Epidemiology of this Association supplement in every way the use of this manual by physicians, and that the attention of certifying medical practitioners be directed in a suitable manner, where possible, to the common errors in the use of the medical certificate and that further emphasis be placed on the desirability of simplicity in certification.

RESOLUTION No. 3

WHEREAS the present satisfactory status of vital statistics in Canada is due in large measure to the effective leadership and service rendered by the Dominion Bureau of Statistics,

AND WHEREAS the statistical studies undertaken by the Dominion Bureau on various aspects of vital statistics have been most helpful during the past few years,

Be it resolved that this conference express to the Dominion Bureau its sincere appreciation and express the hope that the Bureau may be able to continue to conduct studies in vital statistics, such as those published during the past few years.

BOOKS AND REPORTS

The Improvement of Native Agriculture in Relation to Population and Public Health. By Sir A. Daniel Hall, K.C.B., LL.D., F.R.S., D.Sc. Published by the Oxford University Press, London, England, 1936. Canadian agents: McAinch & Co. Limited, 388 Yonge Street, Toronto. 104 pages. Cloth, 83.25.

This volume contains the Heath Clark Lectures delivered by the author at the London School of Hygiene and Tropical Medicine. It is well printed and amply repays the brief interval required for reading.

Since many persons engaged in public health activities occupy themselves nearly exclusively in attempts to control infectious diseases, the question at once arises as to whether there could be any relation between a change in agricultural methods and an improvement in public health. The author realizes this and answers the question with a quotation from a report by Dr. A. R. Paterson:

"From his experience, first as a doctor and secondly as a sanitarian, he may recite two facts; namely, that one major cause of ill-health in the African is a poor dietary, and that another is the insanitary conditions resulting from insanitary and wasteful farming."

A careful reading of this book would convince a sceptic that, while the teaching is directed to Africa, there are valuable lessons for Canadians. Indeed the author cites as an example the wastefulness of continuously growing wheat in our Western provinces. This is done in the first chapter in which the author outlines the history of crop rotation and points out its advantages. The second chapter deals with the disadvantages of shifting cultivation practised in India and in Africa, and, using the Orient as an example, suggests that native farmers be taught to make compost pits to prepare excreta for use as fertilizer. The

marked danger of having too great a number of livestock in Africa is discussed in chapter III. Not only are large areas of land removed from cultivation but the steady cropping lays bare the soil and encourages erosion. This is reminiscent of recent developments in the United States. To the reviewer the most interesting chapter is the fourth, dealing with African native dietaries. It completely dispels the illusion so prevalent in current advertising that primitive people, obeying the dictates of instinct, are properly nourished. Changes in agricultural methods, with the introduction of new crops, should improve nutrition. The final chapter, dealing with administration, does much more than deal with administration, since it discusses most adequately nutrition in the Mother Country. A quotation from this chapter closes the review and emphasizes a previous statement that the book has valuable lessons for Canadians:

"There is need to make many members of the medical profession nutrition-conscious. I am told that instruction in that subject, especially in its recent developments, occupies but a perfunctory place in the medical students' overweighted curriculum."

E. W. McHenry

The Bacteriological Grading of Milk. By G. S. Wilson. Issued by the Medical Research Council, National Institute for Medical Research, Hampstead, London, N.W. 3, England. Published by His Majesty's Stationery Office, London, England. Canadian agents, Wm. Dawson Subscription Service, Ltd., 70 King St. East, Toronto. 392 pages. 7s., 6d.

This report presents a critical inquiry into the methods available for the bacteriological grading of milk in respect of cleanliness and keeping quality. It is not concerned with the question of the safety of milk as

shown by the absence of pathogenic micro-organisms.

Three procedures current in the bacteriological testing of milk were examined in great detail; viz., the plate count, the coliform count, and the methylene blue reduction test. Some idea of the magnitude of the experimental work done may be gathered from the fact that 138 pages are devoted to a critical study of the plate count, 56 pages to the coliform count, and 83 pages to the methylene blue reduction test.

The plate count is severely criticized. The technique is complex, and even under favorable conditions the experimental error is very large. It is recommended that the plate count test be discontinued in the testing of ordinary raw milk.

It is suggested that the coliform test may be of value in the testing of pasteurized milk. This test may serve as an index of the efficiency of the processing if performed on freshly pasteurized milk and as an index of subsequent contamination or exposure to unsuitable temperatures if performed on bottled milk at the time of delivery to the consumer.

In addition to investigating the several factors concerned with the current methylene blue reduction test, the authors have improved the test so that it may be applied to high-grade milks. The modification consists essentially of half-hourly inversions of the tubes containing the milk and methylene blue so as to keep the fat and micro-organisms in more or less homogeneous dispersion. It is recommended that the modified methylene blue reduction test replace both the plate count test and the coliform test in the grading of raw milk.

Under the heading "Miscellaneous Tests", a number of other grading tests have been investigated. The Breed smear test, on account of the rapidity with which it may be carried out, should be of assistance to farm inspectors and agricultural advisers, and it should be of service at collecting stations for distinguishing be-

tween clean and dirty milk. No reference is made to the possible use of the Breed smear test for obtaining information regarding the condition of milk prior to pasteurizing.

Part II of the report, 76 pages, is devoted to a discussion of the interpretation of tests used in the grading of milk.

Professor Wilson and his associates are to be congratulated on the thorough manner in which they have carried through an arduous task.

P. J. Moloney

The Mortality from the Principal Cardiovascular-Renal Diseases.

A study of the experience among the industrial policyholders of the Metropolitan Life Insurance Company, 1911 to 1950. Monograph 4 in a Twenty-Year Mortality Review. Published by the Metropolitan Life Insurance Company, New York. Canadian Head Office, Ottawa. 80 pages.

This monograph, the fourth in a series prepared by the Statistical Bureau of the Metropolitan Life Insurance Company, presents an analysis of the deaths from the principal cardiovascular-renal diseases among industrial policyholders over a 20-year period. The statistical material presented relates to the many millions of the company's industrial policyholders who are drawn from nearly every state of the Union and from practically all provinces of Canada.

The group of diseases studied includes heart disease, chronic nephritis, cerebral haemorrhage, diseases of the arteries, and angina pectoris. In the United States this group of causes is responsible annually for more than one-third of the total number of deaths. The period covered by this review was one of shifting standards in the classification of causes of deaths for purposes of mortality statistics. The difficulty of obtaining comparable rates, due to these changes, is largely overcome by treating the group as a whole.

The data for the group as they relate to policyholders in age-range

1 to 74 years are analyzed by age, sex and colour. The five diseases in the group are also analyzed separately in detail. The trend over the period is discussed and the importance of the principal cardiovascular-renal diseases as a cause of death is emphasized. Contrary to prevailing opinion, the mortality from the principal cardiovascular diseases has, in general, exhibited a downward trend over the 20-year period 1911 to 1930.

M. A. Ross

The Specificity of Serological Reactions.

By Karl Landsteiner, M.D., The Rockefeller Institute for Medical Research, New York. Published by Charles C. Thomas, 220 East Monroe Street, Springfield, Ill., 1936. VIII+178 pages, 29 tables, bibliography: 1164 references. Price, \$4.00 postpaid.

This monograph is primarily a summary of the highly creditable research work of the author and his colleagues. For the most part, the chemical aspects of immunological reactions are considered. Within this field, material presented by other workers is fully discussed and a comprehensive bibliography is included with each chapter.

The introductory remarks give a general picture of the problems involved, together with a series of adequate definitions. The chapters dealing with the specificity of proteins, cell antigens and antibodies are quite comprehensive, although at least a passing reference to bacterial haemolysins and their antigenic properties was to have been expected. The large volume of work on artificially conjugated antigens or azo-proteins is very ably dealt with in a readable fashion, while the closing chapter on specific cell carbohydrates and lipoids is extensive, valuable and stimulating.

The international reputation of the author would in itself recommend the book. In a relatively small volume, a large amount of very important work is presented, while the

bibliography alone is sufficient guarantee of its usefulness to all research workers in the field of immunology.

L. N. Farrell

Second Annual Report of Hospitals in Canada for the Year

1933. By R. H. Coats, LL.D., Dominion Statistician. Published by the Institutional Statistics Branch, Dominion Bureau of Statistics, Ottawa, 1935, by authority of the Hon. W. D. Euler, M.P., Minister of Trade and Commerce. 67 pages, with tables.

The second annual report of the hospitals in Canada covers all except mental hospitals. It serves as a supplement to the special directory of hospitals which has also been recently published.

In 1933 there were 876 hospitals for the care and treatment of the sick in Canada with a total bed capacity of 58,822, an increase of 4,686 beds over 1932. Among the points of particular note we observe that 700,284 patients were under hospital care in 1933, the daily average number being 39,231. The average stay in hospital was 13.1 days for newborn infants and 21.2 days for children and adults. The per cent of hospital beds occupied for the year was 62.5. A point which attracted the reviewer's attention was the information contained in table 46, page 62 of the report. In public general hospitals in Canada the per cent of beds occupied in 1933 is lowest (39.4 per cent) in those of 1-10 beds capacity and increases steadily to 75 per cent in those of over 600 beds. In a similar fashion the average length of stay of patients in these hospitals is 10.0 days in the smallest type and 18.6 days in the largest. Information on hospital facilities, personnel and out-patient departments is also included.

The data presented are of interest not only to the hospital administrators but to workers in all branches of medical endeavour, and the available details are presented for each province in a set of 47 tables.

A. H. Sellers

CURRENT HEALTH LITERATURE

These abstracts are intended to direct attention to articles that have appeared in other journals during the past month. Any of the journals referred to may be borrowed for three days or longer if desired. Address requests to the secretary of the Editorial Board.

Lead Poisoning from Theatrical Grease Paint

The classical symptoms of lead poisoning appeared in a young actress. The diagnosis was confirmed by the detection of large quantities of lead in the faeces and urine. The source of the lead was said to be a grease paint containing approximately 40 per cent lead. The same brand of paint was used by several other members of the cast but no other case of lead poisoning occurred. There were, however, many complaints among others of tiredness, ill health, and headaches while using the grease paint previously. This group therefore illustrate what a great variability there is in the susceptibility to lead poisoning.

A discussion on the diagnosis of lead poisoning emphasizes that traces of lead may be found in the urine of healthy people due to ingestion of small quantities of the metal with such food as meat, beans, cherries and other fruit. Actually in lead poisoning the patient usually excretes at least 0.1 to 0.3 mg. of lead per litre in the urine. In the diagnosis, anaemia in association with a high stippled red cell count should always suggest lead poisoning. The two diseases presenting a blood picture which resembles lead poisoning are acholuric jaundice and chronic malaria, in both of which the reticulocyte count is higher than normal.

E. L. Bartleman and C. Dukes, *Brit. M. J.*, 1: 528, 1936.

The Diagnosis of Infectious Mononucleosis

Because of its benign nature, little attention was devoted to infectious mononucleosis (also called monocytic angina or glandular fever) until about

1920 when several persons who had what was diagnosed as hopeless acute lymphatic leukemia recovered wholly in one to two weeks. The interest stimulated by this resulted in considerable literature in the subject in the past few years. The authors briefly describe the clinical picture and the epidemic nature of infectious mononucleosis. The causative factor has not yet been confirmed.

The diagnostic test here described is that of Paul and Bunnell (1932) modified by Stuart et al. (1934). It is based on the presence of sheep heterophile antibodies in the blood of the patient. Another condition that will give sheep-agglutinating antibodies is serum sickness. If an apparent infectious mononucleosis case with a history of serum treatment gives a high sheep-cell titre, it may be necessary to adsorb the serum with guinea-pig kidney or beef cells. The latter will completely adsorb the sheep antibodies of serum sickness but not those of infectious mononucleosis.

The authors feel that the test is simple but accurate. Since 1933 they have encountered in Providence, R.I., and Hartford, Conn., 62 clinically, cytologically and serologically positive cases of infectious mononucleosis.

C. A. Stuart and F. L. Mickle, *Am. J. Pub. Health*, 26: 677, 1936.

Salmonella Infection in Batavia (Java)

This paper reviews the present methods of classification and technique employed in diagnosing the various types of *Salmonella* infections. In the central laboratory there are diagnosed annually by cultural methods 300-400 cases of typhoid infection, 80-180 cases of paratyphoid A, and about 20 cases of so-called "paratyphoid B" infection. During the 5 years 1930-1934 these so-called "paratyphoid B" strains were examined by modern methods, especially antigenic analysis. No strain corresponded to the true paratyphoid

B. The strains examined from 115 cases showed the following distribution: (a) An organism allied to both *Bact. typhi-murium* and *Bact. paratyphosum B* accounted for seven cases, mostly gastro-enteritis, a proportion *typhi-murium* accounted for 28 cases, mostly gastro-enteritis, a proportion being due to the Binn's variant; (c) "Stanley", two cases of gastro-enteritis; (d) "Derby" (?), five cases, mostly gastro-enteritis; (e) *Bact. paratyphosum C* accounted for 28 cases, mostly simulating typhoid infection but with varying complications; (f) *Bact. suisstifer* var. *Kunzendorf*, 11 cases, mostly typhoid-like with complications; (g) "Newport", 10 cases of enteritis, and typhoid-like infections; (h) *Bact. enteritidis*, nine cases of typhoid-like infection, abscess formations, dysentery, etc.; and (i) other types, 15 cases.

C. E. DeMoor. Mededeel. v. d. dienst. d. volksgezondh. in Nederl.-Indië, 24: 98, 1935. Abst. in Bull. Hyg., 11: 498, 1936.

Incidence of Contagious Diseases Without Quarantine in Children's Wards of a Hospital

For three years the practice of quarantine on the occurrence of a case of a common contagious disease in the children's wards of the Fifth Avenue Hospital, New York, has been abandoned, and specific convalescent serum has been substituted in half of the susceptible groups while the other half were kept as controls. No secondary cases of rubella, whooping cough or scarlet fever occurred. Convalescent mumps serum apparently reduced the morbidity from 2.8 per cent to 0. Measles convalescent serum reduced the incidence of cross-infection from 25 to 7 per cent. The order of frequency of cross-infections was measles,

chickenpox, and mumps. Forty-seven per cent of the patients were susceptible to the disease to which they were exposed and the cross-infection rate of the susceptible was 4.6 per cent. The cross-infection rate in the control group did not appear to be increased by the lack of quarantine.

C. Keresztsuri, D. Hauptman, W. H. Park, and F. Bartlett, J. Paed., 8: 166, 1936.

Post-Mortem Findings in Fatalities Due to the Use of the Arsphenamine Group

In the 17-year period 1919-35 there were 63 deaths in the United States Navy following the administration of the arsphenamines. This report is a pathological one on 44 autopsies made on males all under 43 years of age. All the patients had syphilis. The duration of infection was less than 6 months in 55 per cent and over 6 months in 45 per cent. The time interval between the final injection and onset of symptoms was less than 6 hours in 18 cases, over 6 hours in 20 cases, and unknown in 6 cases. Novarsphenamine caused the largest number (34) of the deaths, which was to be expected as this is the arsenical most extensively used in the Navy. None of the patients died after the first injection of an arsenical; 12 died after the second; 23 after five injections or less; 20 had received more than six injections.

The striking pathological findings were frequent hemorrhages and oedema in the various organs of the body. The hemorrhage and congestion and capillary damage are responsible for the diverse clinical signs of arsphenamine poisoning which differ only according to the anatomical structures affected.

S. S. Cook, U.S.P.H. Rep., 51: 927, 1936.

